American Machinist

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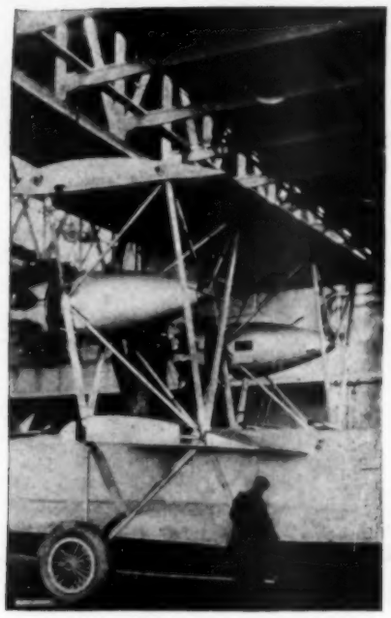

A TWELVE HUNDRED ACRE AIRPLANE PROJECT

C. A. Van Dusen

Vice-President and General Manager

THE Martin Company organization goes back to the time when Glenn Martin built his first airplane in a little church in Santa Ana, California, in 1909. Since that time its operations have been located in three other places, Los Angeles, Cleveland, and finally in Baltimore.

The first Martin airplane was of Mr. Martin's own design and constructed with his own hands; after building it he taught himself to fly. Further development, for a period of years, was financed by giving exhibition flights in various parts of the country.

When I first became associated with the company, the shop consisted of a small amount of floor space in a Los Angeles loft building. The shop force consisted of six men, and the equipment of a post-type drill press, an emery wheel, and a blacksmith forge, all hand operated. The grindstone was equipped with a bicycle pedal drive, and a Root blower was the only power-driven equipment in the shop. Instead of welding, we brazed, and this blower supplied the air for the two torches we owned.

Plant 19 Acres
Airport 900 Acres
Seaport 285 Acres
Room for Expansion Unlimited

Parts were made almost entirely by hand, and thus the safety and success of the airplane depended more upon the skill and judgment of the mechanic than it does today. But even in those early days nothing was left to chance in the matter of determination of strength and fitness for the purpose. Our methods may have been more crude at that time, but we made frequent physical tests on strength parts.

The Los Angeles plant expanded steadily until in 1917, just before it was moved to Cleveland, it occupied four floors of a loft building and was equipped to work in wood and metal in a manner that compared favorably with other airplane plants of that period.

Our Cleveland plant embodied the experience we had gained in our Los

As far as the eye can see, can the Martin company expand its operations

Angeles plant, plus added space and equipment. It proved to be well adapted for the types of airplanes then being produced, and we began to develop still better manufacturing methods, a distinctive system of production control, and further, we brought our engineering to a high state of efficiency.

Since its inception, the aircraft industry has been more dependent upon pure science than any other industry. There has probably been more effort expended in scientific research, in design, and in the development of materials for the use of aircraft, than in any other single industry in the same period of development.

It is an axiom in our organization that, "No design, material, or method is sufficiently good for use in aircraft." The result is, that as fast as better basic principles, better materials, and better methods have been discovered, they have been adopted, and still others sought. This policy at the present stage of development of aircraft necessitates constant changes of design, equipment, and methods. This is reflected in the flexibility of our equipment and the layout of our plant. The rapid changes in design and methods are illustrated by the fact that our Los Angeles plant was primarily a woodworking plant, our Cleveland plant about 50 per cent wood and 50 per cent metal, while our plant here at Baltimore is almost 100 per cent metal.

During our occupancy of the Cleveland plant the principles of design changed from all wood to composite construction of wood and mild steel; later came all-metal construction of molybdenum steel tubing and strong aluminum alloys. This trend has gradually developed into built-up members of the aluminum alloys and highly stressed fittings made of various high-grade alloy steels.

The foresight necessary to provide flexibility in plant, equipment, and methods presupposes a still more flexible organization, one that is ever ready to take advantage of the rapid developments in scientific knowledge. At the same time, each step taken must be fundamentally sound, so that nothing is left to chance in producing successful aircraft. A successful organization however cannot base its progress upon the labor of others; it must have forward looking members who can at times anticipate the work of others and pioneer in methods, materials, and design.

We did not abandon an obsolete or rundown plant at Cleveland. It was sold as an aircraft plant and is at present in operation. We disposed of it because our organized forethought visualized that it would eventually be too small for the large airplanes we would be called upon to produce, and for the development which we visualized, if we were to maintain our place in the industry.

We also foresaw the necessity of locating at an ice-free port on tide water so that we could make shipments of aircraft to foreign ports, and make delivery in commission, of large flying boats, which would be a problem from a location where the waters are frozen over for a considerable portion of the year. We, therefore, entered into an intensive study to determine the best and most suitable location for what we considered to be our future needs. During this study we considered locations in almost every portion of the United States, including the Mississippi Valley, the West Coast, and the East Coast as far south as Florida.

The City of Baltimore was an early consideration and eventually became the basis of comparison by which we measured other locations. As time passed, its advantages became more and more apparent. Baltimore offered a climate almost ideally suited to our purpose, far enough South not to be subjected to troublesome ice and fog, but yet far enough North to be in close proximity to sources of material supply. It offered a good labor market, and we finally selected it as offering many advantages which were not obtainable in any other location.

As a result, we selected and purchased a site on Chesapeake Bay comprising 1,200 acres, with over five miles of shore line and a mile and a half frontage on the Pennsylvania Railroad which furnishes shipping facilities and rapid communication with the heart of Baltimore, 9¼ miles distant.

Before purchase was undertaken, the site was studied with the greatest care. It was found that land runways as long as 7,000 ft. in the direction of prevailing winds, and 5,000 ft. in almost any other direction could be built without restricting the expansion of the ground reserved for manufacturing purposes. We also found protected water take-off and landing courses for any direction of wind in the contiguous arms and bays of the Chesapeake. Other parts afforded ideal locations for seaplane and airplane hangars, separate overhaul shops, railroad stations, as well as rapid highway communication with the City of Baltimore. The purchase of the site was consummated without raising property values, although it consisted of 39 separate parcels of property.

The plant layout is the result of several years' study by the organization itself, using the cumulative experience gained in the development of the Cleveland and Los Angeles plants. We endeavored to visualize our requirements five years, and even ten years hence, and to provide for expansion of buildings fifty years hence. The nature and expanse of the site enabled us to devise a plan which will permit this. The present buildings represent one-third of a tentative 10-year plan. Ground space for the future expansion of the office building is also provided for, separate from the factory.

A study of the factory layout will show that we have grouped the engineering, tool design, planning, experimental, and tool making departments, as well as the physical and chemical laboratories, immediately adjacent to each other. Further study will indicate that the tool department is immediately adjacent to the tool design department, the engineering department is immediately adjacent to the experimental department, and the planning department is in the heart of these arrangements. This is to facilitate intimate contact between the control of the design and manufacturing organizations and to give all departments an opportunity to consult with each other regarding engineering designs as related to tool making, planning, and manufacturing. It gives the engineering department close contact with the actual construction of the experimental types of airplanes, and enables tool makers, tool designers, and production engineers to discuss and criticize engineering design of new types as they develop. It also eliminates difficulties which would otherwise occur and contributes materially to a better product.

The north end of the factory building proper contains the manufacturing and unit assembly departments. The sheet metal department is located along one side of the building immediately adjacent to raw stores. The machine shop is in the center, also adjacent to raw stores. This enables these departments to obtain their raw materials with ease and dispatch, and minimizes material handling problems.

The finishing room has been placed between the manufacturing and the final assembly departments and is located so that assemblies are put through the various covering and finishing processes and delivered ready

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The Future of the Aircraft Industry

That the aircraft industry has had a successful past no one can question. Many are the brilliant and difficult achievements accomplished in the development of successful transportation, communication, and national protection—in perfected design, manufacture, and operation of aircraft and its allied services including navigating equipment, radio communication and guidance, and ground facilities. Each year has seen surer aircraft operation; time schedules are flown on time; greater speed is combined with greater safety.

We look back upon history, each year of which has shown more progress than the preceding one. We look forward to a future of continuing progress and continuing growth in the industry.

Our own belief in this future is exemplified by the permanence of our construction and the provision for expansion incorporated in our Baltimore project.

—Glenn L. Martin.

for final assembly. Shipping and storage adjoin both the final assembly and finishing rooms. We have a production flow with the minimum amount of back tracking, and at the same time, we retain a flexibility in our arrangement that is not approached by the single-purpose production line.

Airplane manufacture requires large uninterrupted areas of floor space. We have found it possible to provide an economical high-strength, light-weight structure, notwithstanding that the trusses are 100 ft. and 125 ft. clear span with 25 ft. center to center spacing. There are only two rows of columns in the entire building.

The plan contemplates that the second phase of the ten-year plan may be taken care of by extending the manufacturing area to the east and expanding each division according to its needs. The final assembly may be extended by lengthening at either or both ends, or additional assembly floors of any size desired may be added on the south. Ground has been reserved for additional raw material storage, and also for packing and shipping warehouses. All this reserved space is adjacent to the present departments. Regardless of what changes may take place in our plans, as our needs cause variation, we are sure of being able to obtain any arrangement that may be desired.

Good plants can be secured by using engineering help from outside sources, but good organizations cannot. We laid the basis of our present scheme of organization when we organized a tool design department and an order department which had expanded into a planning department even before we left Los Angeles. The Martin Company has long recognized that the organization of a company is more important than the plant it occupies and that we can progress no faster than this organization is capable of leading.

The present organization, outside of the sales department, is divided into three groups: engineering, purchasing, and manufacturing. The chief engineer has charge of all airplane engineering and the chemical and physical laboratories.

The purchasing agent has charge of purchasing, receiving and disbursing rough stores. The factory manager is responsible for all manufacturing activities, such as planning, inspection, tool design, finished part stores, plant engineering, employment and service department, and the physical control of all labor connected with these departments.

Production control is invested in a committee, composed of the heads of factory departments and representatives of the engineering and purchasing departments, and is headed by the factory manager. This committee of the whole originates master schedules covering each project. These schedules set the date of final delivery, and working backward from that date, specify the completion of all work in every department; engineering, tooling, parts manufacture, and assembly, down to the receipt of raw materials, each in its proper sequence.

These charts are also the authority and basis of subsequent detail planning in the production department. Inasmuch as each and every department has a voice in forming these schedules, it insures full co-operation in arriving at the ultimate end desired—delivery of the finished product.

AN EXTENDED USEFULNESS

W. A. Bates
Production Manager

WHERE the production department is a part of the factory organization, there is no feeling on the part of the shop that it is encroaching on any of its prerogatives, hence, there is no resistance, either active or passive, to it. As a part of the shop organization it can discuss shop methods without seeming to over-step its authority. Such a relation saves wear and tear on the nerves of all concerned because all realize their common responsibility and are equally acquainted with the circumstances that occasion pressure.

Another advantage is the fact that the usefulness of the production department can be extended to cover phases of shop management that, under any other arrangement, require duplication of effort. Planning, for instance, must precede intelligent ordering. Being part of the shop organization, this planning is recognized as a function of the production department. The department does its planning with a more intimate knowledge of conditions than a non-shop department could have, and also with the knowledge that its planning, initiated in conference and approved, will be carried out not because of executive pressure, but because the planning is logical and agreeable to all concerned.

The planning and production department, as we call it, performs five important functions. It does all the planning and routing, and issues every order that goes into the shop, be it production, tools, or maintenance, and it follows up and records the progress of work.

Our product has so far been manufactured to order in lots varying from one plane to two hundred. They have been of many different types, designed to meet particular and specific conditions in this and foreign countries.

The future will probably see a continuation of this practice. Orders may call for either single- or multi-motored jobs. They may be for land or sea, and they may be torpedo, bombing, patrol, observation, pursuit, training, mail, or transport planes. Designs change constantly, as do methods of construction and the materials from which the planes are made. Such wide variations necessitate the setting up of a simple, yet practical, method of visualization and follow-up that leaves nothing to chance.

To take care of this variation in type and quantity we have evolved a simple, flexible method of ordering that indicates both sequences and exceptions. It can be extended or contracted indefinitely to indicate our desires for cost reports.

In using this Master Order method, each contract has assigned to it a separate series of numbers. One con-

"Dural scratched is Dural scrapped" applies equally to the storeroom and to the shop

tract, for instance, might have the 1000-1099 series. The master order is broken down into as many divisions as we require in order to get accurate costs. It can thus be made general, or can be extended to cover a specific item. Manufacturing, for instance, might be 1001, tools 1002, or different manufacturing processes might be given a series of numbers like 1004, 1005, 1006, to separate the costs of lathe work, milling, and drilling, if need be. The cost of each would be kept separate and combined under 1001. To particularize still further, the different plane parts and processes have been assigned letters in order until we come to "W" for ground test. These letters are used as a suffix to the master order series. The fuselage frame is the basis of assembly and is given the letter "A." Flight controls are "B," engine controls "C," and so on down the line. Manufacturing parts for the fuselage would be 1001A, tools 1002A, and so on.

With the general and sub-divisions indicated, the next step is to indicate precedence. This is done by following the letter with a number indicating the order of preference. A good example of this is the upper center wing. The letter "L" designates this, and all parts that go into the assembly bear that letter. The wing beam is the first sub-assembly required and the order for it would be written 1001-L-1. The second preference is the rear beam and this would be L-2. The same procedure is carried throughout all operations, ordering materials, making tools, and on down to the final assembly. The result is that one can pick up a piece and immediately recognize the contract and assembly to which it belongs and the order of its importance.

Our scheduling has the same objective as that of any other type of manufacture, but with our close-knit organization possibly we place more stress on preparation than is usual. The production schedule for a major contract is prepared by the production committee consisting of all department heads. Our scheme of

organization recognizes that planning is the chief function of a department head, and each one is expected to conduct his department so that he has time to give this planning preference. When a schedule is made up by those who have to design and build the product, directed and supplemented by a production department that is part of the shop organization, such a schedule is bound to be more than the expression of a mere hope, and the records, instead of being the history of a contract, are a record of achievement.

Date of delivery is established by contract and forms the basis of the schedule. Knowledge that this is so eliminates uncertainty from the scheduling, and the jockeying for more time that marks scheduling in many instances, is entirely absent. The scheduling itself becomes almost automatic, the problem being how best to meet the dates.

With the delivery date set, scheduling necessarily must be done backward from that date. The result is, that instead of the engineering and draughting room taking what time they think they require, leaving the shop the rest, as is usually the practice, they find it necessary to schedule and plan to meet the "all-units ready" dates set by common agreement. It is recognized that the work in the shop cannot be hurried beyond what can be accomplished by better methods and more men. Nothing is ever done to make the workers believe that important work is to be slighted to gain time. From this it must not be judged that design is hurried. It is not, but it is planned and scheduled like other operations and the sequences and planned dates are met.

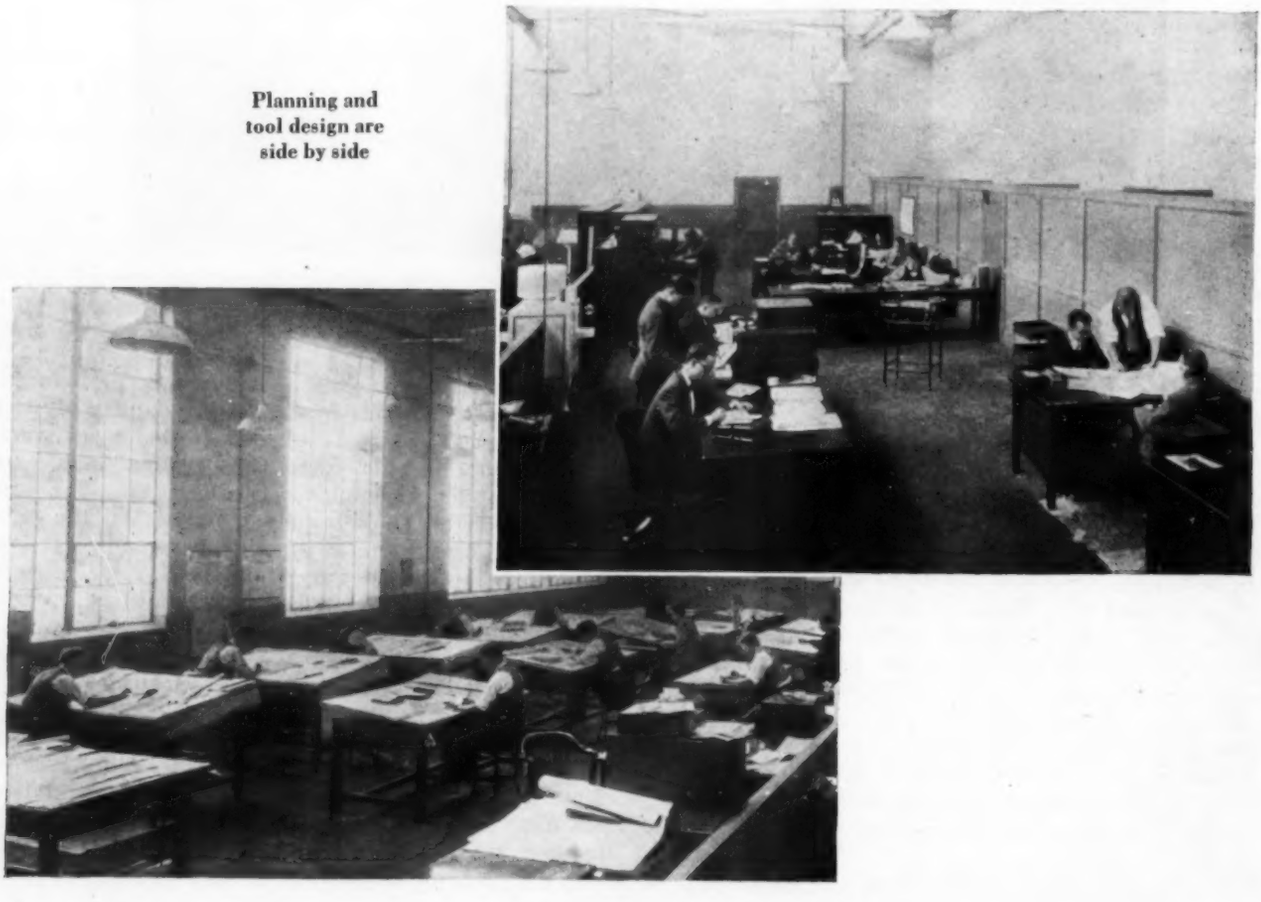
In arranging the schedule, the time necessary for final assembly is subtracted from the delivery date, and this automatically becomes the all-units-delivery date for the different parts. For example: the upper center wing all-units-ready date may be Feg. 10. It requires seven days for it to go through the finishing processes, therefore the wing assembly date must be Feb. 2. Since it requires ten days to assemble a wing, all parts and sub-assemblies must be ready Jan. 22. This method is much more simple and accurate than the cumulative-time method usually used.

After the schedule dates have been set, we encounter the usual shop troubles in meeting the dates, but we concentrate on the exceptions. Inasmuch as an entire sequence of units-ready-dates are set, we know whether we are ahead or behind schedule, and do not wait until near the finishing date to check up and then find ourselves in trouble.

Progress is visualized graphically in terms of individual planes, and it is possible to follow progress and fix responsibility for failure before it becomes serious.

While the follow-up section is wholly a production group they really serve the production committee as a whole. The committee arrangement and the status of the production department as one of several shop departments responsible for the maintenance of a schedule rather than an executive proxy demanding production, changes the complexion of their duties entirely. The attitude of the follow-up men is changed and they are considered an aid instead of an irritant, all of which increases the importance of the production department.

Planning and tool design are side by side



NOTHING IS LEFT TO CHANCE

L. C. MILBURN
Chief Engineer

IN THE early days of aviation, one individual was inventor, designer, builder, and operator. At first each builder was concerned with one particular airplane only. It was soon found, however, that there are more varieties of airplanes than there are of boats. The variation between canoe and ocean liner is almost equalled in the variation between gliders and 6,000-hp. flying boats.

Before the war, all airplane engineering was of the experimental style. The force consisted of an engineering head and a few assistant designers and draftsmen. The engineer did his best to match up the established principles of mechanics and structures with the sketchy and unreliable data available on aerodynamics, often calling upon imagination and faith to bridge the gaps. Much was of necessity left to chance.

In the popular mind, it is but a step from automobile engineering to airplane engineering. Nothing can be further from truth, and the failure to recognize this fundamental fact has resulted in many setbacks and other troubles. The airplane navigates in a fluid medium, the air, and alights on land or water. Its design demands the combined technique of aerodynamic, structural, mechanical, and marine engineering, and it is from these fields that we recruit our engineering and factory personnel.

During the war many airplane projects were undertaken. It became the fashion to have the undivided attention of a separate engineer on each project. With increase in demand and the resulting production methods, simultaneous work on eight or ten models has since then become quite common. Meanwhile, the wide scope of the airplane problem has demanded much broader study and subdivision for its proper analysis and control. It has become necessary to modify and develop the engineering organization plan to cover the ground thoroughly and to secure proper co-ordination and economical overhead. During the twenty-one years of its existence, the Martin company has passed through all phases of the problem, and by progressive development has evolved an engineering organization plan which fulfills present requirements and provides for practically unlimited future expansion. The barnstorming period in both design and practice has passed.

With quality of product and interchangeable manufacture as an objective, the engineering department must handle many matters which received little consideration in the early days of aviation. A considerable volume of important engineering correspondence must be maintained. The managing, planning, and scheduling of engineering work have become quite as important as studies of aerodynamics and structures. One group of engineers, for instance, is employed to do nothing but maintain an effective system for control of weights of detail parts and finished planes. A great deal of time and attention is given to research of materials and to the protection of materials from corrosion and deterioration. Various subsidiary groups must be maintained to take care of engineering standards, specifications, engineering cost, estimating, patents, and similar work left largely to chance in earlier days.

The combination of the group system and the project system is found to give the best results. This arrangement is in reality a combination of the system which developed in aviation during the war and of the group system which has been used almost universally in automobile plants.

In the project system, an engineer is placed in charge of each project. To him are assigned such assistant designers and draftsmen as he may require. He obtains advice on various technical matters from expert engineers employed for the purpose and serving all project engineers.

In the group system, the work is divided into sections according to the various parts of the airplane, such as power plant, wings, body, hull, tail surfaces, and landing gear, and the head of each group is responsible for the design of his specialty on all models manufactured.

The straight project system has several drawbacks, the most important being a lack of uniformity in design of different projects and a lack of co-ordination between different projects. This leads to waste in time, tools, and material. The group system also has shortcomings, the most important being the tendency for functional and mechanical interference between different parts of the airplane and lack of co-ordination between the work of the different groups.

This company endeavors to utilize the merits of each system and avoid the drawbacks. This is accomplished by working out all details of design in groups, and at the same time placing the responsibility for proper co-ordination of all parts of each airplane upon one individual engineer. To explain how this system works, an example will be given in which it is assumed that all preliminary study work has been accomplished and that there is available a general arrangement drawing of the proposed airplane and a set of detail specifications covering the design and construction. It is then the duty of the co-ordinating engineer assigned to that particular model to

No longer is one individual the designer, builder, and operator of aircraft

become thoroughly familiar with the specifications and characteristics of the airplane. Having done so, he meets in conference with the chief engineer, assistant chief engineer, chief draftsman, structural engineer, and the group heads of all the groups who will be called upon to work on that particular model. The specifications are read word for word, and they are discussed in detail as the reading proceeds. After the interested parties are familiar with the project, the group heads prepare preliminary layouts of all parts. This work is supervised by both the co-ordinating engineer and the chief draftsman. As fast as layouts are completed they are checked for strength, mechanical perfection, weight, and suitability for manufacture. This work is done by the co-ordinating engineer, who initials each layout as fast as he is satisfied. These layouts are then the basis for detailing.

If the job is a new one, the layouts are amplified and sufficient details are drawn up separately to permit construction in the experimental department. If the job is a modification of a former type and is to be made in quantity, further minor layouts are made and a separate detail drawing is made for each separate piece down to the smallest part. Each group head is assigned one or more engineers to serve as parts-checkers within his group and under his supervision. This is done so that design and checking work proceed simultaneously. This permits more rapid release of drawings upon completion. This method also permits the checking engineer to be thoroughly familiar with the difficulties which are likely to occur in his section of the design. The co-ordinating engineer examines finished drawings to assure himself that all provisions of the original design have been properly carried out. He does not make a mechanical check of each drawing. This work has already been accomplished, as previously explained. Immediately after examining the drawings, the co-ordinating engineer submits them to the chief draftsman and chief engineer for review, after which they are released for construction. In general, a co-ordinating engineer is assigned for each separate model, although, when two or more models are substantially similar, the same engineer may handle them.

In some plants the chief draftsman functions simply as a drafting room foreman, but we have obtained better results by assigning to this position a man who can function both as a manager and an engineer. This combination makes for more rapid action, as he is able to make decisions on all details of engineering without waiting for consultation with engineers who may be away from the plant or otherwise unavailable. One of his fundamental responsibilities is expediting work, and to accomplish this purpose, all co-ordinating engineers and design group heads report directly to him. He is thus able rapidly to direct matters of design and procedure which arise continually. This arrangement conserves the time of the chief engineer, who would otherwise be called upon constantly to arbitrate differences of opinion between various group heads.

The plan also includes an assistant chief engineer who plays an important part in the organization. He enters into all general discussions of design or management. He has direct charge of all technical work, such as structures, weight control, material research, and specifications, definition of physical properties for use in design calculations, preparation of technical data, research and specifications for protective coatings, and similar matters. He carries on engineering correspondence with sources of supply and with customers. His duties include the preparation of engineering data for sales use and for customer's requirements, such as bid specifications

and drawings, data for customers' approval during construction, handbooks for service maintenance, and similar material.

An important part of the engineering work is done in the study group. This group is composed of engineers with wide experience and technical education. They are continually at work upon new types of airplanes. As many as thirty or forty arrangements of a given design problem may be worked out. This is done to insure that all possible variations of any airplane have been investigated before final selection is made. This group reports directly to the chief engineer and works in daily consultation with him. After the correct aerodynamic and structural arrangement of a design has been agreed upon, the work is made ready for the customer's examination, or is turned over to the entire engineering organization for design of parts. The study engineer may be called in for consultation during the progress of the work, but in most cases all necessary instructions are contained in the detail specification. This is prepared in consultation with the study engineer. Such a procedure frees the study engineer for new work.

All work of a technical nature having to do with the analysis of forces, estimating of weights or balance, checking of parts for strength, and static testing of all assemblies requiring test, is concentrated in the structural group. This group also conducts investigations and tests upon new types of construction or new materials. All special testing apparatus for structures and all reports of tests conducted are reviewed and approved by the structural engineer. All weight reports taken from actual construction are returned to him for study and recording. Matters of aerodynamics are referred to the chief engineer or to special engineers whom he may appoint. All engineering work is scheduled for release dates. In some cases it becomes necessary to extend schedule dates because of unexpected developments encountered in design work, or changes in design made at customer's request. Nevertheless, considerable benefit is derived from the arrangement of all work in orderly time sequence, and from the effort to complete work on scheduled dates. Furthermore, scheduling of engineering work is necessary as a basis for planning of tool and manufacturing schedules—when once started it presents no difficulties.

The main engineering room is 134 ft. long by 49 ft. wide, located with north light on the long side and west light on the other. Side windows 10 ft. high extend all along the room. In addition, sloping skylights are provided in the ceiling, beginning 18 ft. from the floor. The main roof is 24 ft. from the floor. The floor is creosote block laid on concrete, eliminating noise and floor reflection. All equipment is of the most improved type available. Pantagraph draughting machines are provided for each table, and each design group head has a special table with large file drawers, and, in addition, a metal, lettersize, four-drawer filing cabinet.

With plenty of light, ample room, and an absence of confusion or interruption, our engineers can cencentrate on the problems before them. It is very obvious that, in the manufacture of airplanes, neither theory nor practice can stand alone. Every problem, no matter how plainly the figures show its solution, is given the test of actual construction, and every shop practice is given the test of theory, in either or both of the laboratories and the experimental department. In this way nothing is left to chance and the combined efficiency of the engineering and shop forces is made available.

ELIMINATING DOUBT

Robert Young
Foreman, Experimental Department

UNDER the direction of the engineering department as far as design is concerned, and under the factory as far as control of labor and schedules is concerned, the experimental department is used for experimental work on everything pertaining to aircraft. We start at rock bottom, getting the information necessary on any particular material or design for the benefit of both the engineering and manufacturing departments. Even before parts are designed, we are busy working out new problems and trying out new ideas so that the designer can have first-hand information, based on facts and actual tests.

Quality is put into an airplane at the beginning. It is safer and more economical to have experimental work done in a department organized for that purpose, rather than have to do it in the manufacturing departments. It is better to make up airplanes and parts experimentally than to find structural weaknesses later. With our facilities, positive proof can be given where a doubt exists, and by producing a complete ship from a manufacturing point of view, based upon engineering data, the production end of the plant is not hampered in any way. Even errors of judgment cannot be tolerated in airplane work.

The experimental department is approximately 70 ft. by 150 ft., entirely enclosed. In this room we have a machine shop, sheet metal shop, welding and bench section, wood shop, and assembly section, all equipped with new, modern machinery. Only first-class mechanics of the highest type are employed, for good ideas, coupled with good workmanship, are necessary to make accurate tests. We also take care of our own stock records, and having our own stock bins and stock clerks, we are able to take care of our own parts. All tools used are made within the department, as well as the necessary fixtures and jigs. Practically all the work done on experimental ships is done inside the department, with the exception of plating and painting. Very few parts have to be made in the manufacturing departments. As our sweeper says, "We don't bother nobody, and nobody bothers us."

This department is located adjacent to the engineering department. Being able to get necessary information quickly, and having control of all trades involved, very

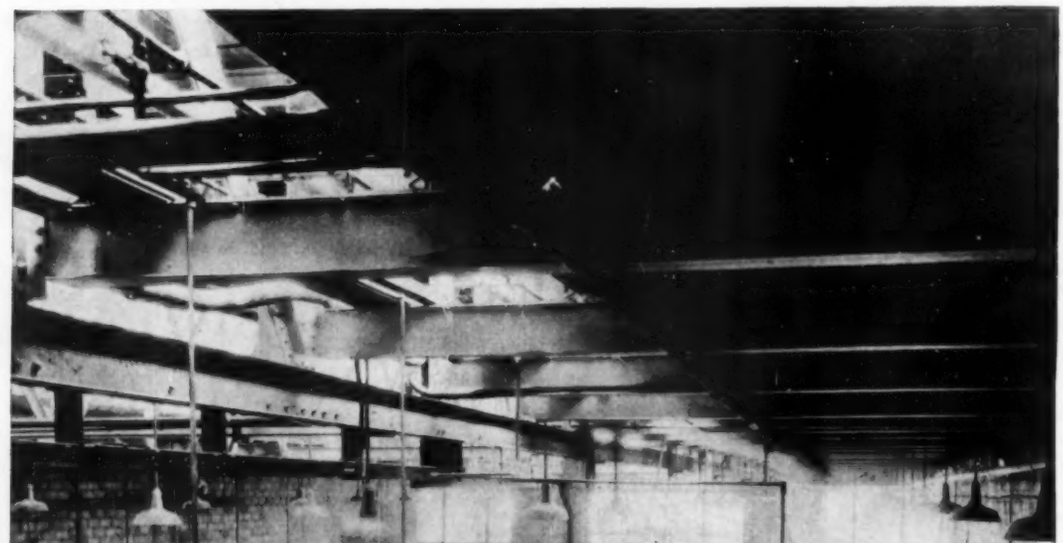
little time is lost in getting a job through. Orders are issued direct from the engineering department to the experimental department foreman.

The foreman of the experimental department is a practical shop man, and aside from carrying out orders from the engineering department exactly as received, he represents the manufacturing point of view. If a part is required for a test of any description, he makes it as ordered without comment, but if it is a part of an experimental plane, he questions its manufacturing practicability if necessary and endeavors to submit an acceptable substitute. Thus, when a plane goes into manufacture, it is a practical manufacturing proposition.

Experimental work is financially ruinous unless it is intelligently controlled and based upon completed engineering data. It cannot substitute for theory, it merely confirms and co-ordinates theory with shop practice. Before any work is started on an experimental plane, and indeed before any arrangement drawings are started, a "mock-up" is made.

All our airplanes are of metal construction, but the mock-ups are built up of lumber, full size with all bulkheads and bracing built in. The outside of the hull, the wings, and the tail structures are covered with heavy paper. The gas and oil tanks are built up of wood and likewise covered. Standard equipment is used as far as convenient. Engine and flight controls, seats, floors, and armament, if any, are installed complete. When finished, the mock-up is an almost perfect visualization of what the finished ship will be. An engineer or shop man can visualize a drawing, but many people cannot, so the mock-up gives the customer or his representative an opportunity to make any desired change.

When the customer has approved the arrangement, t



Before actual work is started, a complete dummy plane visualizing the engineer's concept is built in the experimental department

mock-up is photographed as it is taken down, and is used to guide the designer in his arrangement plans for the experimental plane. In building the experimental airplane the experimental foreman decides what tools, or methods, are to be used in making the parts or assemblies. All completed parts and assemblies are inspected by our own inspector, and if the parts go on a government ship, they must also pass government inspection.

During the assembly period, there is a continuous inspection by shop inspectors to insure the correct assembly of parts. As a limited supply of tools is made on an experimental job, a great deal of care and accuracy must be exercised by the mechanics making the assemblies. After the ship has been assembled, inspected, and checked, the ground test is run. The test of flying is the final check.

Another of our duties is the building of test specimens, and the development of new ideas to be used in the construction of our ships. Each ship must have certain tests made of its vital parts, so that there is positive proof by physical test that the parts are strong enough to meet the requirements. For instance, destructive tests are run on a complete fin, rudder, stabilizer, elevator, aileron, wing beam, hinge fitting, engine mount, and on practically everything that is subjected to strains and stresses in the ship. The element of chance must never enter.

SATISFYING UNCLE SAM

R. B. GRAY
Chief of Laboratory

THE TESTING laboratories supplement and extend the work of both the engineering and manufacturing departments, not only proving their accomplishments, but reaching out continually for something stronger, better, and more economical than that in use. Wing structures are destroyed, complete keel sections are bent and twisted to prove that no error has been made.

In the ordinary run of production, good engineering, supplemented by efficient manufacturing, is accepted as sufficient. We, however, do not accept these results as final. Without attempting to be critical, the laboratories check the judgment of engineering design and the efficacy of mechanical operations. The reward of such carefulness is almost absolute certainty that if a plane crashes, it will not be because of structural or aerodynamic troubles.

Recently one of our diving bombers, a "flying truck," the newspapers called it, dove vertically under power from an altitude of 12,000 ft. pulling out of the dive at 2,000 ft. after attaining a speed of 275 miles per hour. Only a few years ago, any aviator would have considered this operation a short cut to an audience with his Creator. Furthermore, this plane carried a 1,000-lb. bomb under its body as it dove. The object was to drop the bomb in an absolutely vertical direction toward the target, instead of dropping it when passing over it, as is usual. The purpose of the test was to find out what would happen if the bomb-releasing mechanism failed to function at the bottom of the dive, something which manufacturing and engineering ability, supplemented by the work of the testing laboratories, could not be absolutely sure about. At 2,000 ft. the bomber came out of the dive and leveled off without releasing its bomb. The pilot had gambled on our choice of factors, but he knew, as we did, that the factor of safety decided upon was present—because the laboratories had proved it.

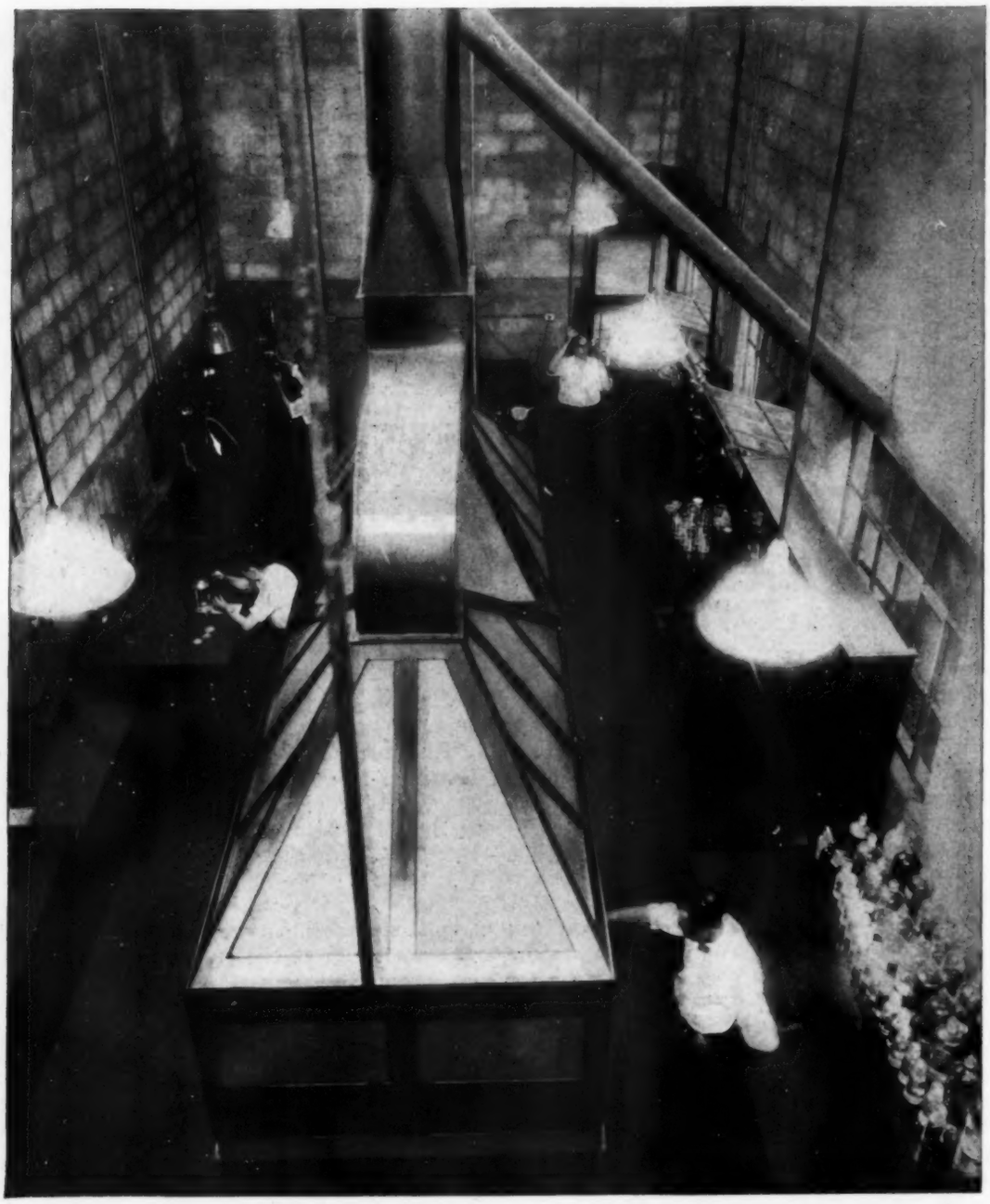
The testing laboratories are the result of years of experience in developing materials, methods, and designs to meet the rapid strides of aviation and the exacting requirements of government specifications. They operate as a branch of the engineering department, and include completely equipped chemical, physical, and photographic test units. Like the experimental department, this department is entirely self-contained. It has a small machine shop for preparing physical and chemical test specimens, or for manufacturing special test tools and fixtures.

All materials, from the finest linen thread to the heaviest bars of metal used in manufacturing planes, must pass critical inspection. The materials are given tests, either chemical, physical, or both, before they can be released from the bonded stock room to the production stores.

This work is done by a staff of specialists, each of whom has had intensive training in his particular work and additional special training in the problems of aircraft manufacturing as related to the work he is performing. In addition to being specialized in various phases of testing, these are practical men with a thorough knowledge of manufacturing processes and production methods.

The chemical laboratory, operating under the direction of the chief chemist, is laid out to avoid lost motion. Analysis is begun at the balance table at one end of the room, progresses from table to table as various operations are performed, and is completed at the last table at the opposite end of the room. Tables, built to our specifications, are of oak, with 1¼-in. soapstone tops, each table having built-in fixtures for electricity, air, gas, and hot and cold water. Equipment consists of Chainomatic balances, stirring apparatus, cooling trays, sulphur racks, and similar units, some of special design, but all included with a view to time saving without sacrifice of accuracy.

Tried and proved methods of analysis, chosen for their accuracy and speed, are used in the laboratory, for there is no good reason why a laboratory cannot be placed upon a production basis and operated to schedule like any other department. The old idea of the mysterious alchemy of the laboratory is passing, at least as far as we are concerned. This unit must handle a wide range of analytical work on plain and alloy steels, copper, Terne plate, solder, brass, bronze, aluminum alloys, soldering flux, gasoline, plating solutions, finishes, and the rest of the vast number of materials which are



The chemist seeks out the intangible and invisible qualities that make perfection

required in the manufacture of airplanes. In a separate room isolated from all chemical operations, accelerated corrosion tests are conducted on samples of corrosion-resistant steels, paints, plates, lacquers, dipping oils, and other protective finishes.

Straight-line, continuous operation is the aim of the layout of the photographic department also. Developing, printing, washing, drying, trimming, and straightening are so separated that there is no possibility of mixing or contaminating the chemicals used. All photographic work in connection with contract requirements, sales, publicity, and historical records is done in this unit.

Physical routine tests are performed in the physical laboratory and all experimental heat-treating, as well as heat-treating of test specimens, is done there. Equipment is laid out, as in the other laboratories, to follow the sequence of operations from start to finish of a job. Equipment and methods are such as to keep the personal element at a minimum.

Heat-treating is done in a Sentry, 2,400-deg., Globar furnace, equipped with a Leeds Northrup indicating and controlling potentiometer. Oil and water quenching tanks are conveniently placed. Testing machines are two Amsler Hydraulic units, one a 20,000-lb. capacity multiple-poise, double-ram machine with a rating of 200 to 20,000 lb. in seven increments. This is in itself a great advantage in permitting much closer reading of loads by using the load poise best suited to the material under test. An autographic load diagram is made for every test, which acts as a double check on results. The other machine is a 100,000-lb. multiple-poise type employing a single ram. Load poises for this machine

range from 10,000 to 100,000 lb. in four increments. The machine is equipped for tensile, compression, bend, and transverse tests. An automatic load maintainer makes it possible to apply a given load to a test specimen and to maintain that load indefinitely, at the same time drawing a stress-strain diagram.

Hardness tests are conducted on all physical specimens before they are placed in the Amsler machines. For tests which cannot be carried on in the laboratory, such as tests of controls from cockpits, two Chatillon dynamometers are provided, one with a capacity of 2,000 lb., the other of 10,000 lb. An American Dead Weight Pressure Gage Tester is used in testing and calibrating pressure gages to be used for production inspection tests of tank assemblies.

Standardized thermocouples, as well as pipe couples, are also kept in this laboratory. These couples are used with a 30-point switch for standardizing and checking new couples, and with a Leeds Northrup double-scale portable potentiometer for performing periodical temperature uniformity tests on all furnace equipment and instruments in the plant. A variety of special extensiometers, gages, and similar units is provided in connection with tests for engineering developments and research. Laboratory testing machines are calibrated periodically with a mercury calibration box.

Engineering development tests too large to be carried on in the laboratory are conducted in the Experimental Department. Tests for vibration on fuel tanks are conducted on a special machine isolated in the basement of the building. No new fuel tank design development is adopted without vibration tests to prove it. While we believe that our routine methods are sufficient to produce tight tanks, we take no chances, but test each one.

This company pioneered the vibration method of testing tanks, and for over five years has been using special machinery to vibrate tanks to destruction. Our tanks have been so successful that the government has written the requirement of a vibration test on fuel and oil tanks into the specifications for naval airplanes.

ANODIC PROCESS

ANODIZING is an electro-chemical process used to oxidize the surface of aluminum and aluminum alloy parts. The oxide forms a very thin, smooth, dense film, which greatly increases the resistance of the material to corrosion. It also provides an excellent surface for the application of paint, a surface which absorbs a small amount of the paint, and to which it adheres exceedingly well. This adhesion of the paint adds much to the corrosion resistance.

Unlike most electro-plating processes, wherein metals such as nickel and zinc are deposited, the anodic film is formed on all surfaces with which the solution used is in contact. This provides protection against corrosion for the insides of long tubes, and for all the corners and crevices of the parts and assemblies.

The material to be treated is first thoroughly cleaned in a soap solution to remove all dirt and grease, and then rinsed in hot water. It is then suspended from bus bars, and submerged in a solution of chromic acid contained in a steel tank. The material itself is the anode in the electrical circuit. The tank is the cathode.

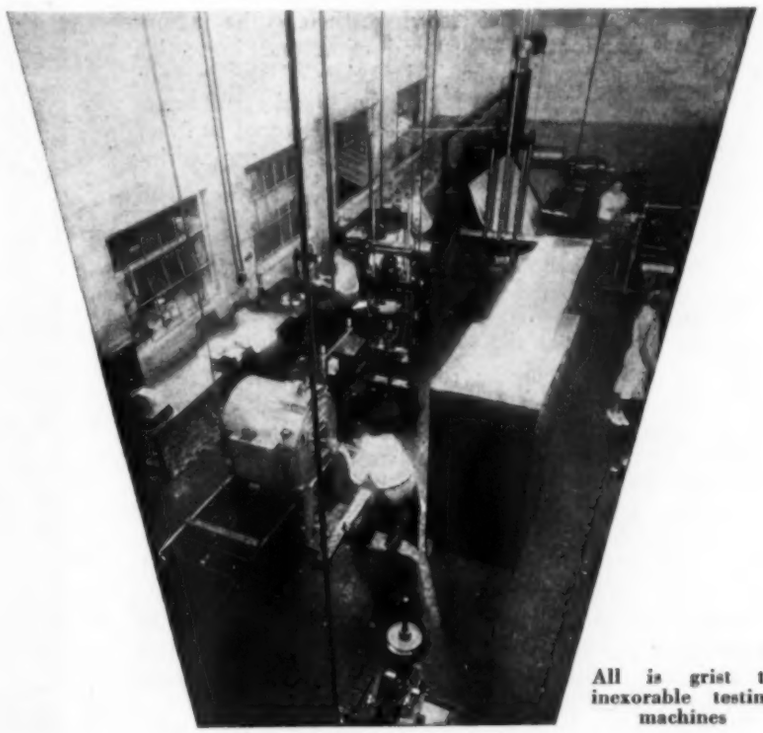
An electrical current of low voltage is then applied. The voltage is gradually increased in accordance with a prescribed time and voltage curve, until fifty volts are reached in the space of one hour. The material is then removed and thoroughly rinsed in hot water.

The equipment now in use was designed to accommodate, when operating on two shifts, the full capacity of the factory, and has been found to meet expectations.

No material other than aluminum or its alloys can be used to suspend the parts being anodized in the chromic acid solution. Therefore, the thousands of screws, clamps, racks, spring clamps, etc., used to hold the work are all made of aluminum alloy.

Because of the injurious effect of the chromic acid fumes upon the workmen, it is necessary to provide a very efficient exhaust system. Fumes are drawn off through slots the entire length of the tank, located on both sides, into tapered ducts leading to the suction side of a slow-speed exhaust fan of approximately 10,000-cu.ft.-per-minute capacity. Because of the susceptibility of high-strength aluminum alloys to corrosion, the use of this metal on naval aircraft was restricted. As a result of several years of experimentation, we developed finishing materials and methods of surface treatment that were satisfactorily resistant to corrosion. The anodic treatment supplements these by supplying a better base for finishing, and a degree of corrosion resistance.

However, the success of any surface finish depends upon coating every part with the proper material immediately after the anodic treatment.



All is grist to inexorable testing machines

METHODS AND EQUIPMENT

H. F. VOLLMER
Factory Manager

WHEN we moved east from our factory in Cleveland, we left behind us our old machinery and equipment, in fact, everything old except our knowledge of airplane construction and what constituted quality. Moving into a new plant equipped with machinery and equipment which we considered to be best adapted to our requirements meant the realization of our vision of ideal conditions.

Mass production in airplane work cannot be accepted in the same sense that it is applied to automobile manufacture. Quality is the result of the combination of hand work and time supplementing accurate machine work. True, skill may be transferred into a machine or mechanism, but judgment cannot be. A $12,000 car may not have had any better machine operations in its construction than a $1,000 one, but they will have been performed at a slower speed, there are more of them, and there is much more hand work and fitting. If this did not add quality, there would be no sale for the expensive car. It is possible to bend or shape sheet metal to almost any desired form, and when the parts are assembled they can be sprung into place easily for riveting and so save a lot of hand labor. They would not, however, stand the loads for which they were designed. In our scheme of management, the shop is solely responsible for mechanical quality. The old idea that the shop staff must be checked continually by inspectors and production clerks that report elsewhere than to the factory has been abandoned. The production and inspection departments are under the jurisdiction of the factory, and it alone is responsible for methods and results once the drawings and materials have been delivered to it.

The experimental department, with its engineering direction and its practical head and staff, acts as a clearing house for the ideas of both engineering design and shop methods. Building an experimental plane in that department for each new contract clears up all manufacturing questions before they reach the shop.

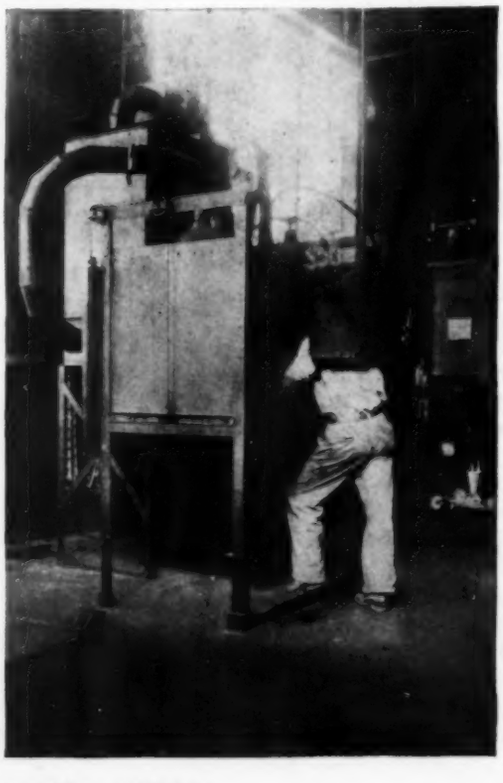
Because of these precautions and because nothing is left to chance, our sheet metal work is outstanding. Good work has become a routine matter, the secret of which lies in careful preparation. As a result, our metal department has been practically compelled to do outside work. It was this same outstanding reputation that brought the building of the metal mast of the cup defender, "Enterprise," to us.

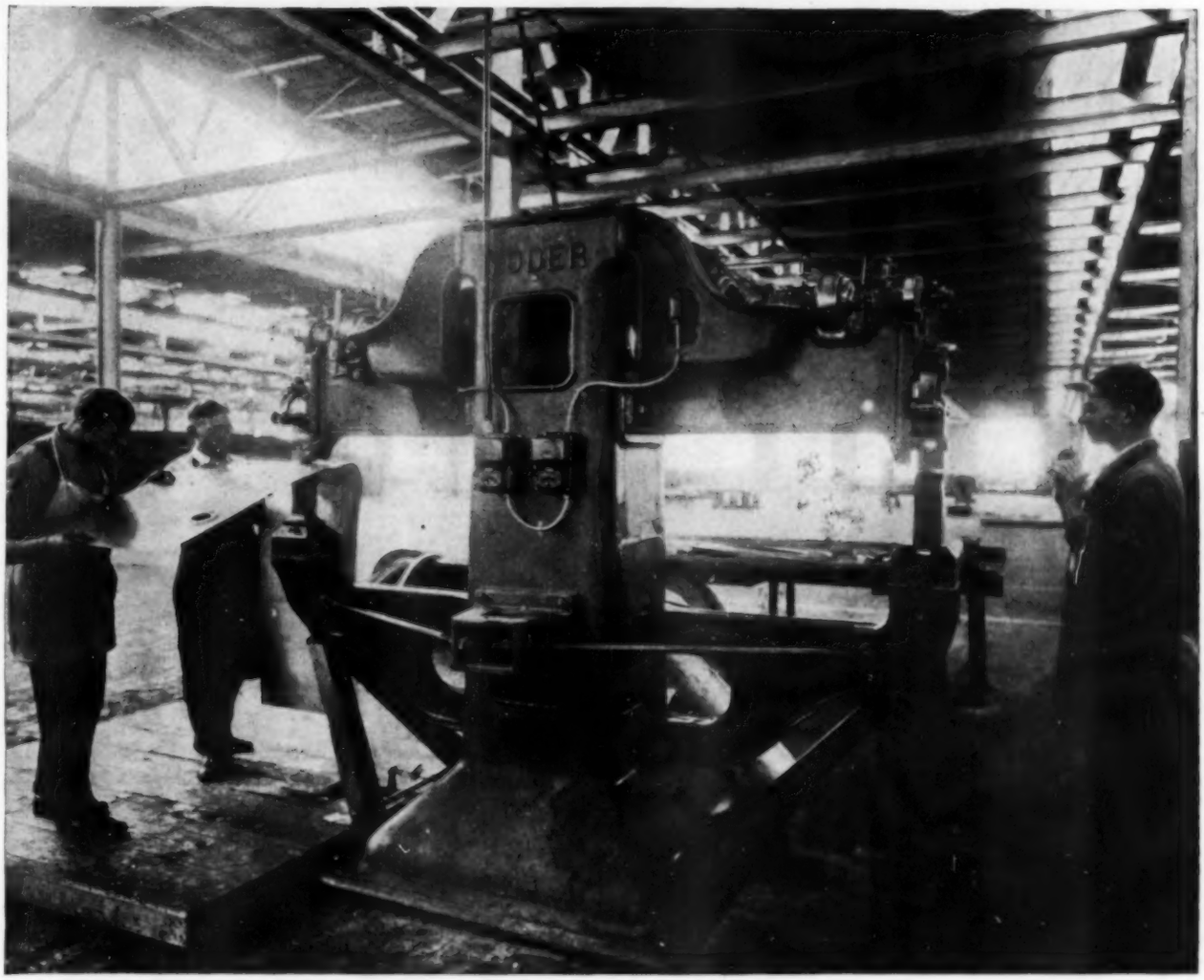
Aircraft design changes rapidly, and quantities are relatively small when one thinks in terms of automobile production. Great care was exercised, therefore, in the selection of equipment. Special types of machines designed for producing parts of one design only were not considered. Standard machines were selected and special tooling adapted to these standard machines.

Neither were machine tools selected with only immediate requirements in mind. Considerable thought was given to the requirements of the future. The size of aircraft is increasing steadily, and because of the necessity of weight saving, alloy metals, with their higher strength values, are used. A machine which would seem to have ample capacity today would probably be too small within a year. For instance, when chrome-molybdenum replaced S.A.E. 1020 steel, the capacity of all shearing and punching equipment was reduced fifty per cent because of the higher shear value of the chrome-molybdenum steel.

Likewise, the plant was not equipped for the manufacture of a single model to be turned out in continuous production. It was necessary to keep in mind that planes of various designs and sizes from the smallest to the largest types would be built with the same equipment, and it was laid out in such a manner that these various types of planes could be run through in as near a production manner as possible. It is surprising to find how well this can be done when proper thought is given beforehand to the problem.

Where the amount of work to be performed permits the installation of only a single machine of a type, it is found better practice to install a machine large enough to cover all sizes of work. The additional cost of operat-





Forming Dural sheet without abrasion

ing a heavier type machine on the small work is more than offset by the availability of the machine when it is necessary to do heavy work. Experience has shown us that it is better to provide a machine too heavy for the work than one of just ample capacity.

The policy which we have found best in the selection of machine tools is to conduct a careful investigation of the equipment required, then after a selection has been made, to standardize on that particular make. Another advantage of this policy is that it is not necessary to buy accessory parts for a variety of machines.

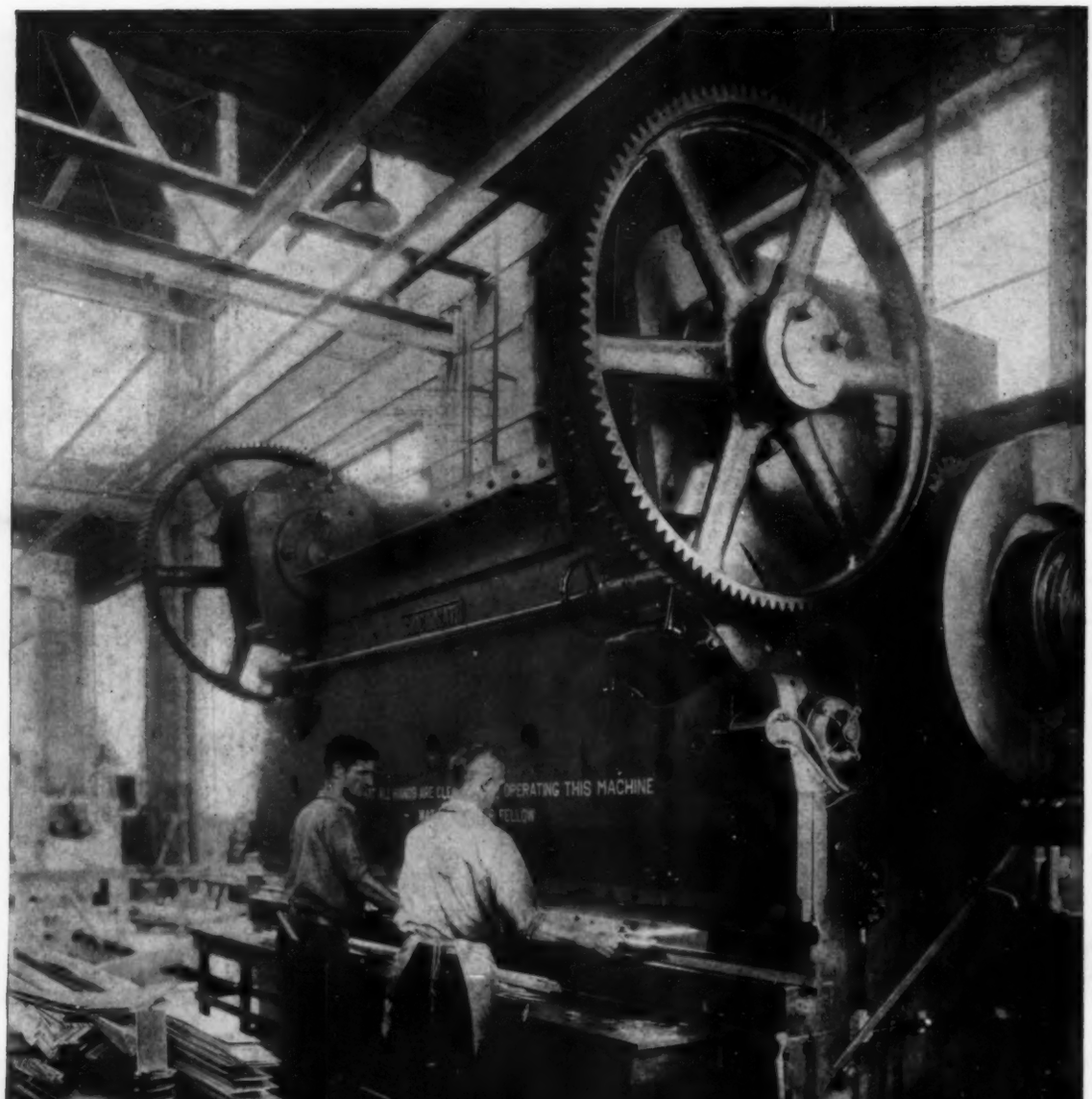
All our machine tools are motor driven and self-contained. This permits the rearrangement of the machinery at will to obtain the best efficiency and to meet the changes of design and size of the parts. It also permits the moving of the machine to the job when it will prove more economical to perform the operations in this manner.

The planning and material department is part of the manufacturing organization and is equipped with modern office equipment for maintaining production records, calculating equipment for the rapid calculation of quantities, and so on. The tool design department, likewise, is provided with types of drafting boards and drafting machines that make for the rapid execution of work. The manufacturing idea is not confined to the manufacturing departments alone.

All parts released from the engineering department are passed through the production and tool design departments for the ordering of material, the issuing of orders, and the design of tools. Each job is carefully considered in the light of tooling to suit the nature of the work to be done and the number of parts to be made. Our policy dictates that the tools provided must pay for themselves on the quantity of parts called for by the initial order or must be necessary to maintain interchangeability. This results in the design of many ingenious but simple tools which can be produced at a comparatively low cost.

A description of equipment is usually uninteresting reading, but in the case of a new plant that represents the best current practice, and possibly forecasts future practice, it becomes news because it shows the trend. The present equipment suffices for 1,700 men and an output of about three large 3-motored flying boats a week. A detailed list of machine tools and equipment is given later on.

The tool-making department is provided with equipment for accurate workmanship in the manufacture of dies and fixtures. For the manufacture of brake dies for forming sheet metal shapes, a 4x16-ft. openside planer is provided. The openside feature also permits the planing of the pads and location points of jigs and fixtures considerably wider than the bed of the planer. The 16-ft. stroke is necessary as it is not considered



Fabrication of angles, channels, and shapes

economical to manufacture shapes in less than 14-ft. lengths, because of the cost of splicing.

Jig borers are provided for the boring of jigs and dies, vertical shapers for the manufacture of blanking dies and other slotting operations. Standard-type lathes, milling machines, and shapers are included for the work best accomplished on these machines. Die-filing machines, upright drilling machines, and the smaller sensitive drill presses are included in the equipment, as is also complete grinding equipment for grinding thread chasers, cutters, drill bushings, gages, and other work of this nature. Flexible shaft machines are provided for the finishing of dies. Because of the quantity of drill bushings, rivet dies, and sets, a hand screw machine of $1\frac{5}{16}$-in. capacity is provided. The tool room has a total of 30 machine tools.

Our machine shop is equipped with automatic screw machines ranging in size from $\frac{1}{2}$ in. to 2 in., for quantity production. A battery of hand screw machines ranging from 1 in. to $3\frac{1}{2}$ in. handles castings, irregularly shaped parts, tube ends, and other items where the quantities are such that a set-up on an automatic machine is not warranted.

This department also has milling machine equipment with dividing heads and vertical milling attachments for the many different operations. The majority of the mill-

ing machines are of the plain type and are satisfactory for most operations. Only one universal machine is included. The machines range in size from a hand miller to the heavy manufacturing type. Dividing heads and vertical milling attachments are provided on 25 per cent of the milling machines. They are interchangeable on all machines, and this quantity is found sufficient.

Vertical milling machines are not included in this equipment. Usually there is not sufficient of this kind of work to keep one machine busy. It has proved better practice to use only horizontal machines and include in the equipment several vertical heads.

Engine lathes are provided for the turning of axles, large-size castings, and other items of still smaller quantity that would not prove economical to manufacture on hand screw machines, or that require a more accurate finish.

Drilling equipment consists of sensitive high-speed drilling machines of $\frac{3}{16}$-in. capacity for small work. A battery of $\frac{1}{2}$-in. capacity, 7-in. overhang machines covers the majority of the work. Several machines with 15-in. overhang are also provided, likewise several upright drill presses of 25-in. capacity. Threading machines for threading bolts and other screw products are provided.

The machine department is provided with equipment for reclaiming the oil from the chips collected from the machines. The sterilized and filtered oil is pumped to an overhead storage tank, and the reclaimed oil piped from this storage tank to a valve directly over each machine.

A total of forty machine tools are included in the machine department.

It is in the sheet metal department that we make the greatest departure from previous practice. This department is equipped with machinery to eliminate hand work as much as possible. It is equipped to make the multitude of shapes that are necessary in our work. Here also are located the salt bath and straightening rolls, also a precision shear that will shear accurate strips 14 ft. long.

A press brake of 500 tons capacity shapes these strips. The salt bath, straightening rolls, shears, and the brake are set up in a production line to accelerate the working of the metal after heat-treatment in the salt bath.

Standard punch presses in eight sizes, with capacities of from 5 to 100 tons are part of the equipment, as also are several nibbling machines, some having a capacity of $\frac{1}{4}$-in. material. Circular shears are used for generating shapes in the thinner gages of metal.

Power bumping hammers are provided for cowling and other work usually done on this type of machine. A self-contained pedestal type machine with a hammer mounted on each side is used, roughing generally being done on one hammer and finishing on the other.

Power slip rolls and beading and wiring machines are also used in this department. The beading and wiring machines are of the deep-throat type. This tends to cut down the capacity of the machine somewhat, but removable brace rods are provided which increase the capacity on the heavy work. In addition this department is equipped with the usual sheet metal hand-operated tools such as folders, hand slip rolls, and stakes.

There are a total of 22 machines in the sheet metal department.

The parts assembly department is provided with sufficient drilling equipment of $\frac{3}{16}$-in. and $\frac{9}{16}$-in. capacity to take care of the drilling of assemblies. The large drills for the wide assemblies have a 15-in. overhang. The equipment includes a machine to test cables up to 25,000-lb. pull, carrying a device that permits the load required to be set. When the machine reaches the indicated load it cuts off automatically, definitely preventing overloading of the cable under test. After proof testing and inspection, cables are passed to the oil treating equipment.

High-speed electric riveting hammers with capacity to head rivets from $\frac{1}{16}$ in. to $\frac{3}{16}$ in. and $\frac{1}{8}$ in. to $\frac{3}{8}$ in. are provided in the parts assembly department. Much of the work can be done with this type of equipment. However, this by no means constitutes all the riveting equipment used in the plant, as this work is also done with the various types of air tools, including squeeze riveters, one-shot impact hammers, and reciprocating hammers. Total equipment of this type includes 272 squeeze riveters, 75 one-shot impact hammers, and 175 reciprocating hammers of various sizes. This equipment is primarily portable, but in many of the operations tools are held stationary in stands and holders and the work moved for the riveting operation.

A total of six machine tools are provided in the parts assembly department.

The bench department is provided with ample facilities for the work required in this department and also with equipment for drilling completely assembled fittings after welding. There are five machine tools in this department.

The welding department is completely equipped with the latest type of acetylene welding equipment. All welding used in the manufacture of aircraft parts by this company is done by this method, no electric welding being used. We keep sixty men constantly busy welding airplane parts.

In connection with the welding department is the heat-treating department for the treatment of steel and Duralumin. Equipment consists of an electric furnace 18x18x72 in., and one 12x15x30 in., a double-deck gas-fired furnace for the hardening of tools, and a salt-bath furnace with a pot 18x18 in. for the heat-treatment of small Duralumin parts. This is also gas fired. In addition there is also electric furnace equipment for the precision heat-treatment of Duralumin rivets.

The heat-treatment of Duralumin rivets must be accomplished with extreme ac-

Welding in the great open spaces—100 feet wide and not a column

curacy, with never more than a plus or minus 10-deg. variation in temperature. Therefore, the equipment used for this purpose is designed to heat-treat these parts constantly within these limits. This furnace heat treats 116 lb. of rivets per hour. An overhead monorail with an electric crane transfers the charge from the furnace to the quenching bath in minimum time.

It is necessary to use the rivets within one hour after annealing. Because of the accurate temperatures required and the necessity for close supervision of this process, the heat-treating of rivets for the entire plant is concentrated in this department. Rivets are distributed after each charge to the various stations where they are being used. Pans of two colors are provided for holding rivets at each station using them. One color is used for one heat and the other color for the next. This enables instant check-up in the event a pan of the wrong color is being used during any period.

Earlier in this description, I mentioned the fact that our sheet metal work was outstanding because the quality was taken care of in the preparation. The annealing of Duralumin rivets is a case in point. Unless heat-treated within limits that cannot be met by commercial electric furnaces without special adjustments of both heat and air circulation, the rivets will corrode rapidly in salt water, then loosen. In some cases they actually drop out.

This action had been observed and was formerly blamed upon faulty shop work. When this could not be substantiated in the face of rigid inspection, it was charged that the shop used unannealed rivets.

Leaving nothing to chance, we had not been bothered with this feature to any great extent, but we did have occasional cases and we *knew* that there was no chance of unannealed rivets being mixed with annealed ones.

Knowing it could not be a shop fault, and although we were securing good riveting as a routine matter, we started experimental work and found that even when heat-treated in small wire baskets, the rivets in the same basket were not the same nor were different batches uniform. We even went so far as to use small wire baskets containing about two pounds of rivets each and to place a thermocouple in the middle of each basket.

The results of this research work again demonstrates the wisdom of leaving nothing to chance. We reconstructed our furnace and now control it to within one half of 1 per cent. It demands many checks and constant attention to prevent over- and under-runs of temperature, but it pays. It requires about 1 hour to heat-treat a charge of rivets, and when finished, they are immediately taken into the shop and all others returned. The bench and floor are kept clean of rivets; one is never picked up and used.

The surface and float department being primarily an assembly department, it is provided with the necessary jigs, fixtures, and benches for assembly work. Included in this department, however, is the specially designed rib cord bending machine, electrically operated, for moving the rubbing block over the form to be bent, and air-operated for supplying the pressure on the rubbing block. This is a special machine designed and built in our plant. There are six machine tools in this department.

No wood is used in the structure of aircraft, and the plant is primarily equipped for the production of metal planes. However, a completely equipped wood-working department is provided for the manufacture of patterns, wood forms and fixtures, and the manufacture of blocking, boxes, and crates for the shipment of the completed planes and parts. There are 12 woodworking tools included in the wood department.

The finishing department is equipped with specially designed spray booths for line production. This equipment includes 5-ft. and 8-ft. spray booths for the finishing of small parts and two spray booths located on the center line of the room. They are equipped with dividing metal curtains that provide four booths 10 ft. in width by 20 ft. long. Provision is made to move these curtains to the side of the booth when spraying large flying boats. There is also a drying room, 30x30 ft. for drying small parts.

Sewing and upholstering departments are an important part of the industry and are equipped with sewing machines, electric cutting machines, and other equipment.

The entire factory is equipped with monorail equipment for the handling of material from one department

to another. The finishing room contains an elaborate system for handling wings, fuselages, and boat hulls. Material is hung on the monorail and is carried through various operations to completion without removal from the track.

There is also a completely equipped plating room for cadmium-plating steel parts and the anodic treatment of Duralumin parts. Included in this equipment are the acid and cleaning tanks, tumbling barrels, and roller barrels for the plating of small parts in quantities. A long tank contains six small roller barrels driven from one motor, but so arranged that any barrel can be cut out of the line. This provides for the plating of small parts up to 25-lb. lots and eliminates the necessity of assorting them as is required when parts are mixed in the larger barrels. There is a still-plating tank 16 ft. long by 30 in. wide by 4 ft. deep. There is included sand-blasting equipment, consisting of a barrel-type machine for the blasting of small parts and cabinet-type machines for the blasting of larger items. In this department is also included the polishing and buffing machines.

Habitual quality demands that every operation be controlled and that the operations that insure quality be, if necessary, compulsory. The chemical laboratory constantly checks finishes and plating mixtures submitted to it periodically to furnish the compulsion if it is needed.

The final assembly department is equipped with the necessary handling equipment in connection with the monorail system; chain hoists, wing easels, wing handling boards, and wood horses are located at the proper places for the handling of the material as the plane moves along the assembly line.

It is also provided with portable scales for weighing airplanes which permits the placing of the scale under the airplane and raising it with hydraulic jacks. The jacks are an integral part of the scale and permit the weighing of the heaviest airplane by three men. This type of equipment also permits the calculation of the balance of the plane, which is not practical with overhead weighing equipment. As before pointed out, nothing is left to chance. All parts are weighed before part assembly. All sub-assemblies are also weighed, but the sum of the sub-assemblies plus other parts, plus rivets and bolts, is not accepted as a final weight without a check.

The inspection department is well equipped with all standard checking tools, such as protractors, height gages, dial indicators, master surface plate, micrometers, checking vises, master square steel, bar trammels, scales, and steel tapes. It is also equipped with angle plates for laying out and checking complicated fittings, jigs, and castings.

Very complete sets of accurate straight-edges, plumb bobs, steel tapes, bar trammels, and special protractors are provided for checking the alignment of wings and complete airplane assembly. The inspection department is, in fact, almost a production testing laboratory.

Approximately 500 portable electric drills of the hi-cycle type are used throughout the plant, which is wired for the use of this equipment.

This type was decided upon because of the low maintenance cost and because of the fact that in drilling airplane assemblies, it is necessary to get into very small spaces and the smallest type drill with the most power obtainable was desired. Inasmuch as cycle changers are required with this equipment to change the 60-cycle current to 180-cycle, two 20-kw. units were installed for the initial installation, with provision for a 40-kw. machine to be installed later. This permits of flexibilty when the plant is running low.

Under the shipping platform, which is 30 ft. wide and 725 ft. long, a basement is provided where the heating equipment and accessories for the plant are installed. There are six hot-air furnaces located at intervals in this basement for the heating of the building and one 92-hp. steam boiler which furnishes steam for heating the office building and the processing in the factory. There is one 675-cu.ft. air compressor and an auxiliary 100-ft. vertical compressor which supplies air at night. There is also provision for two more of the 675-ft. machines. This platform is called "free" because it saved the cost of a power house.

The maintenance department, also located in the basement, is completely equipped for the servicing, repair, and maintenance of the entire plant.

PRODUCTION OF METAL DETAIL PARTS

J. C. Scott

Foreman, Experimental Department

FIVE UNITS, the machine shop, welding, sheet-metal machine, sheet-metal bench, and metal bench departments, are included in what we call the "Metal Department." Each is, of course, equipped with machinery adapted to its requirements. While machine-shop operations are familiar, we have some unusual ones resulting from our class of product, and we also machine, as routine work, materials that cause trouble in many a shop.

Our welding department varies from the usual conception. Much of the work is done at benches in a fashion similar to other production bench work, but so much depends upon first-class welding that we have had to develop the use of materials and processes unknown in most other plants. We have, of course, large assemblies to weld, but wherever welded, assembling is done in a fixture designed for the purpose, thus insuring not only good welds, but the interchangeability of parts and assemblies. We use the gas process exclusively; $\frac{1}{16}$- and $\frac{3}{32}$-in. rod covers most of our requirements.

It is probable that each detail of our welding department may be duplicated elsewhere, but we are quite certain that few complete departments are as modern in set-up. The welding department must represent the best in current practice, for it is essential that our welders do perfect work. Perfect welds are not, however, left to sentiment; destructive laboratory tests are much more reliable.

The necessity for perfect work, so evident in airplane

construction, also affects the sheet-metal department. The quality of our sheet-metal work is outstanding, and this is not merely a local belief. It is necessary that this be true, for a leaky fuel tank or a leaky hull may cost men's lives. Probably it has been mentioned before that we have no trouble with leaky fuel tanks. This is because of the care used in their manufacture.

One of the principal activities of the sheet-metal department is the manufacture of Duralumin shapes, such as angles, channels, and bulb sections, usually in 14-ft. lengths. Equipment for this work includes a nitrate heating bath, a roll levelling machine, a 14-ft. precision shear, and a 500-ton vertical brake, grouped to permit completion of the process in the shortest possible time. Sheets are heated to 930 deg. F. in the salt bath, quenched in water, and again rinsed. This process distorts the sheets considerably, so that it is necessary to run them through levelling rolls. After straightening, the strips are cut and shaped. These operations are completed rapidly, because Duralumin must be worked within an hour after annealing. It can be re-annealed several times without affecting its quality, but the process is expensive.

Another large item from a production standpoint is the cowling. This is a streamlined affair, usually of irregular shape. For example, on a contract now going through the shop, the cowling is egg-shaped. Nose shells, being spherical, are spun, while the rear cowling is "bumped" on a Yoder hammer. In our work, a blank is first developed, then bumped between wooden blocks. If the blank outline is much distorted after completion of the bumping operation, it is checked to determine whether excessive stretching has occurred. All parts are then anodically treated, painted, and sent to stores.

TOOLING

E. P. Barry
Chief Tool Designer

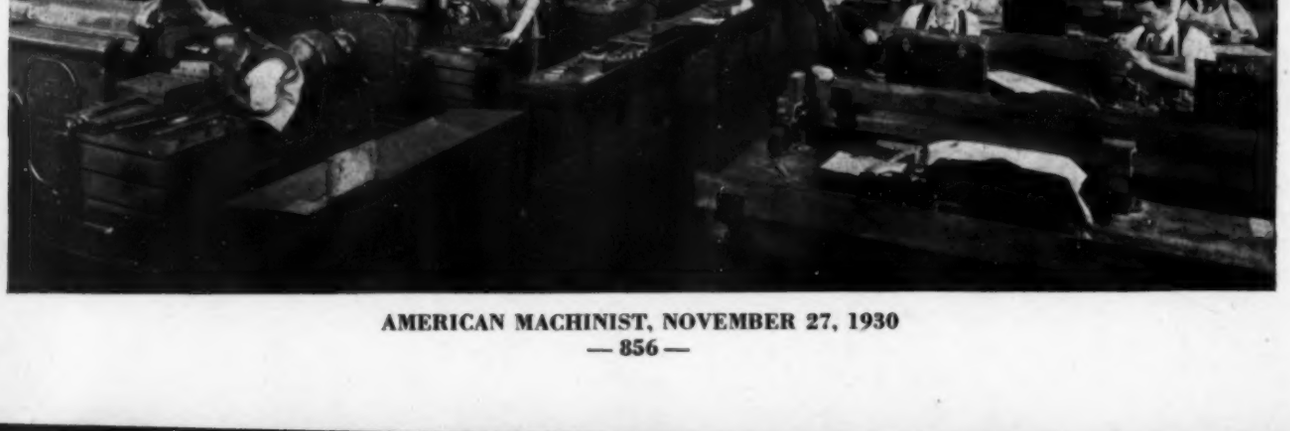
TOOLING for a contract is comparable with, and just as important as, the tooling for a new model automobile. There are certain tools, such as round blanking, round flanging, combination-blanking and flanging, corner round, standard Phoenix and Eclipse, and several other shapes of dies that we consider standard.

For the 8-ft. and 14-ft. vertical brakes in the sheet-metal department, there are standard 60-deg. and 90-deg. dies with straight and offset punches, as well as corrugating dies for walkways, wing, and tail surfaces. Like other industries we have as few variations from standard practice as flexibility of design will permit.

Orders for tools originate in the tool design department and are issued by the production department. The drawings, together with a release showing the quantity required, are the basis of design. The quantity required fixes the design of the die or fixture, because each must justify its cost on a single order. We take no chance on being able to use the same tool for future orders.

The tool designer then plans the tool and forwards the record card to the planning department, which sends out the necessary orders. After a tool is finished, it is inspected. A sample part made from it is also inspected, then the tool is released for production.

Tools for manufacturing aircraft are many and ingenious



Irregular shapes are our greatest problem, but the same rule applies. If the part called for is an irregularly shaped gusset plate and the quantity is sufficient, a punch and die will be ordered; if the quantity does not justify a die, a marking templet is made for use on the nibbler. If holes are required, the templet is drilled, bushings are inserted, and it is then called a marking and drilling templet. If the holes are to be prick punched and drilled, $\frac{1}{8}$-in. holes are drilled in it, and it is then called a "mark, drill, and prick punch templet." Rather a long appellation, but definite nomenclature saves trouble and prevents mistakes.

In many cases the very irregularity of a piece makes a die necessary for a comparatively few parts. In such cases we manufacture a die on that basis. I use the term "manufacture" advisedly, because we have changed over from die making to die manufacturing just as definitely as we have changed the rest of our shop methods. One man lays out the templet, another prepares the die parts. Still another drills and bores the radii holes in the jig borer for the man on the slotter. Finally, one man finishes them on a filing machine, and another man hardens them before they go to the grinder. It still follows that quality is put into a die or any other article by hand work, but very little of it is necessary in the ordinary run of dies.

We also make many welded fixtures, some simple, others complicated. The fixture work that we do is important because of registration features. Fixtures must be built in a manner which will preserve their alignment indefinitely. In many cases we make provision for attaching or registering drill fixtures or templets. Fortunately, the design of tools for an apparatus closely follows the design of the apparatus itself; thus we find no difficulty in bracing our fixtures rigidly and permanently without forfeiting their portability.

HULL ASSEMBLY

T. B. Soden
Foreman, Hull and Parts Assembly

IN DESIGNING TOOLS and fixtures, consideration must be given to the fact that assemblies must often be drilled and riveted in place. It is usually possible to use hand fixtures, but hand riveting is slow and allows more of the personal element to enter than we feel is desirable. Therefore, fixtures must be built to accommodate power appliances, whether they are electric drills, air hammers, or squeezers; at the same time they must hold the detail parts in proper location while the riveting is being done. This is different from making mere fixtures.

It is desirable from every point of view to make subassemblies as large as can be conveniently handled, thereby reducing the number of operations to be done "in place." With this idea in mind we build our transverse bulkheads, floor supports, and frames in white-pine fixtures. Each fixture is made up as a table with a top three or four inches wider all around than the shape of the unit that is to be made on it, and at the most convenient height from the floor.

The surface of each table is perfectly flat; to this surface are fastened hard-maple contour blocks, together with means of locating and supporting such drill jigs as may be necessary. The various detail parts are placed in position and held by blocks and clamps. Drill jigs are then placed and all drilling is done as one opera-

tion. Such operations as this differentiate between manufacturing and building. There will always be a lot of hand work on airplanes to supplement machine work, but it is not necessary to drill one hole and then rivet.

Seaplane design usually calls for a number of watertight bulkheads. We seldom have a failure in these sub-assemblies. Four-ounce canton flannel and bituminous paint form the seal in all such joints.

In laying down a ship or vessel of any kind, the keel must be straight and accurate to the mold lines. In airplane work we call this the keelson, which, in a ship, is inside on top of the keel. The keelson is made up of a great number of parts and frequently has more than one step in it on which the ship rides successively as it gathers speed. Until this keelson lies straight in its place, true to molded form and without force or restraint to make it do so, the basis of quality in a seaplane is not present.

It is manifestly impossible to describe all the operations entering into the manufacture of an airplane, unusual as some of them are, but we can epitomize the work done. Further, we can evaluate the statement that our sheet-metal work is outstanding by watching the assembly of a hull and the fitting necessary.

All hulls are built in an inverted position, that is, bottom side up. In building up a fixture for this purpose, we start with a 2x8-in. plank fastened to the floor and extending the full length of the hull. In the center of this plank we run a true working center line from end to end. On this line we lay out the center line of each bulkhead true as to distance and angle. A few inches ahead or abaft each bulkhead center we erect a 4x4-in. post firmly braced and truly perpendicular. After the posts are set they are tied together with diagonal bracing, the whole making a rigid structure with a true longitudinal center line. A true horizontal working line is marked on the posts about three feet from the floor, and this line should represent the deck stringer of the ship. Each of the center posts is cut off at the proper length and angle to support the keelson, using the horizontal line on each post as a base. The keelson, when set on the posts, must touch the top of each and be true with the longitudinal floor line.

Transverse frames and bulkheads are then located and riveted, held plumb and square by 2x6-in. cross members fastened to the posts. It is for this reason that they must be rigidly anchored. Three or four stringers, "ribands" we call them, are laid longitudinally along the cross frames to fair the bottom into its proper mold line. These $1\frac{1}{4}$x$1\frac{3}{4}$-in. spruce ribands hold the frames rigid while the longitudinal members are being riveted between them.

We fit the skin to the frame very much as is done in real ships. Each sheet is fitted in its place and held with a few "make-up" screws. When the entire skin is in place we drill it through the holes already in the frame. The sheets are then taken off, each joint painted and the canton flannel seal applied. Riveting is not a simple operation because we are dealing with a material that is easily marred, and any such marring means fitting a new plate. Another difficulty is that many of the rivets are in places that would be called absolutely inaccessible by shops without seaplane experience.

The thickness of sheets used on the hull varies, those below the waterline being the heaviest. Rivets used in the heavy sheet are usually $\frac{5}{32}$ in. in diameter, on the thin sheets, $\frac{1}{8}$ in. Rivet spacing depends upon the strength required. All lap joints have a staggered double row of rivets spaced $\frac{1}{2}$ in. apart. We use three kinds of air tools for riveting, the squeezer where we can, next the one-shot impact hammer, while for riveting the skin, we prefer the standard air gun.

When the hull is completed, it is turned over, placed on its fitted truck, and wheeled off for a water test. This test consists of filling each compartment with water to 6 in. above the water line and allowing it to stand one hour. All joints and skin rivets are inspected to make sure they are absolutely water tight. It is in the hull assembly that we see the fruition of the policy of leaving neither safety nor quality to chance. If the hull does not present a smooth symmetrical assembly, it is almost impossible to get it past this test.

FINISHING

J. L. Leonard
Foreman, Finishing Department

ANYTHING from zero to a 100-ft. hull must be handled in the finishing department of a plant turning out airplanes on a production basis. Having been submitted to the test on 60-ft. hulls, we are fully confident of our ability to meet these requirements. In fact, we are able to handle anything that can be moved into or out of the department through doors 50x18 ft.

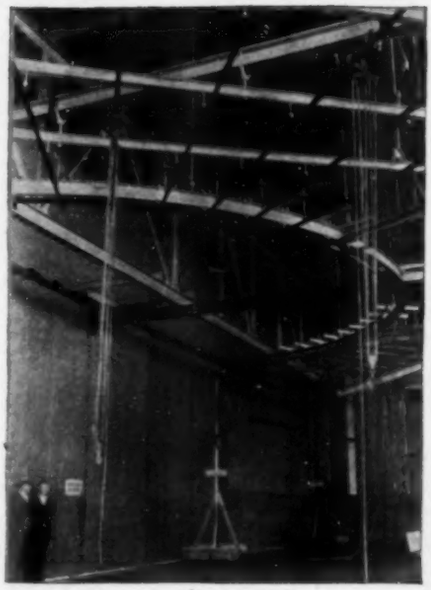
Two tunnel-type spray booths, 20x20 ft., open at both ends, provide this flexibility. Each has a metal curtain to subdivide it into 10x20-ft. booths when the work will permit. The monorail system allows an overhead capacity of 18 ft. through either booth, and by means of its various switches permits the moving of any part of a plane from any part of the factory to the finishing room, and from there to the drying, storage, and final assembly.

The finishing department is 100x312 ft., and lies between the hull assembly and final assembly departments. Ample room for wings, hulls, and parts in process is provided. Since the production department plans the sequence of finishing, parts are received in plenty of time to finish and dry them properly. For the same reason, we do not have to store them too long before they are used.

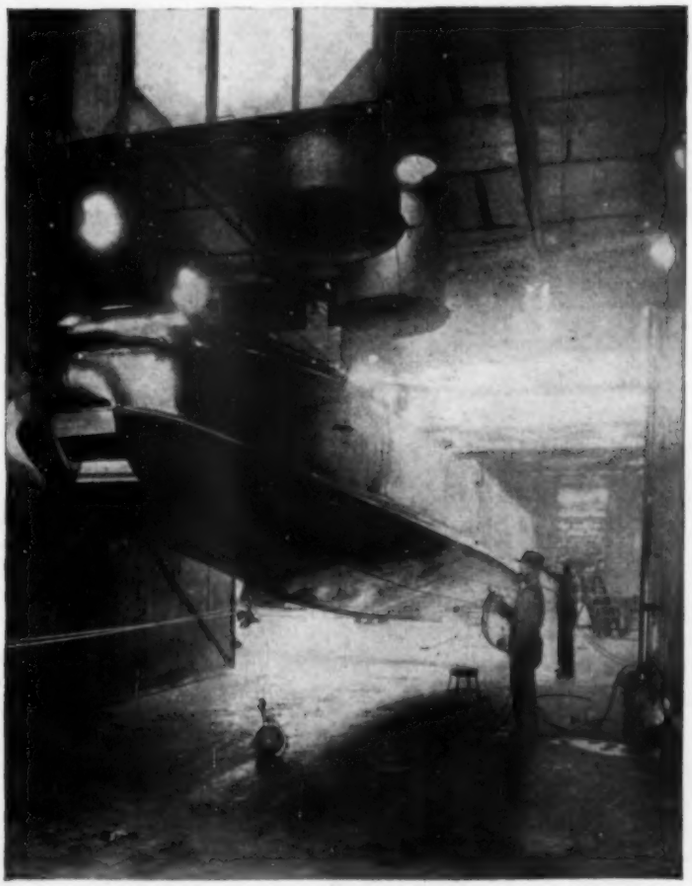
A hot-air drying room, 30x30 ft., is provided for accelerating the drying of smaller units in quantity. The monorail serves this department as it does the others, providing a continuous flow of production with little effort.

In addition to the above we have a complete equipment of smaller paint spray booths, paint mixing machines, and dipping tanks, as well as equipment to fabricate the cloth covering for the wings and an upholstering department which is a self-contained unit of the finishing department.

Hulls are turned on rings and trunnions



Between finish and assembly, a network of monorails



Seaplanes must be protected against the corrosive action of salt water

WING AND TAIL SURFACES

H. J. KRAMER
Foreman, Surface and Floats Department

AIRPLANE WINGS are constructed of a large number of fore and aft ribs assembled to wing beams. At times, these ribs are stamped—at others, built up of channel and bulb sections. Assembly fixtures for these ribs are made up of well-seasoned wood, and are carefully laid out to act also as master templets. Sample ribs, carefully formed, are sent to the fabricating department as guides in making their shape gages.

In assembling the parts of a wing rib, newly annealed Duralumin rivets are used. Riveting is done with an air squeezer or a one-shot impact hammer, consequently the actual operations, while important, are simple. Therefore, we use this department for a training school, of which many of our best workmen are graduates.

Wing beams consisting of webs, bulkheads, and chords, together with steel and Duralumin forgings, are assembled in wood-base fixtures. Wood has several virtues in our work, where so many different shapes are required. It is cheap, light, and will not stand abuse, an important consideration where the product must be assembled without strain. Since sheet Duralumin is a comparatively soft metal, it is easy to spring parts of an assembly into place, a procedure which naturally sets up stresses. Our practice requires parts to fit into place without forcing, and the two legs of an angle or the three of a channel must be at right angles all along the length of the piece, while the piece itself must lie without rock on a surface plate. Therefore, we welcome the use of wood, especially on light parts, because it shows the effects of abuse or unusual strain. Furthermore, it does not scratch Duralumin. We do, however, use metal locating blocks.

FINAL ASSEMBLY

LESTER BENSON
Factory Superintendent

JUST AS in manufacturing layouts everywhere, raw material enters our plant at one end and completed airplanes leave at the other. Probably in no other line, however, unless it be our sister industry, shipbuilding, does the bulk of the mechanism increase so rapidly as it does in airplane work. As a consequence, our final assembly room follows the architectural plan of the cathedral or regimental armory more closely than that of the factory. This room has an unobstructed floor space of 34,375 sq.ft. It is 125x275 ft. with 28-ft. head clearance. Doors at each end give a clear opening 125 ft. wide and 28 ft. high. This means that a number of the largest type planes can be on the assembly line at the same time without the necessity of jockeying to escape columns or other obstructions.

The floor is uniform with the rest of the plant; wood blocks laid on a concrete base. Numerous flush-type ring and eye bolts are anchored in the concrete for rigging tackles when necessary. Almost 20,000 sq.ft. of non-glare glass furnishes natural illumination during the day, and the artificial lighting is arranged so as not to diminish the clear headroom or cast deep shadows.

The production methods used in assembling depend upon both the size of the plane and the number of contracts going through the shop. If only one type is in production, we run solid lines the full length of the floor and bring the completed planes out one end to the ground test area. If two or more types are in production, the assembly floor is ample to allow the starting of one or more lines each way from the center. For this reason duplicate concrete aprons of 9,300-sq.ft. area have been provided outside the door at either end of the assembly floor. Each apron is within a large graded and fenced enclosure, and planes can be serviced, tested, and stored if necessary, under full protection.

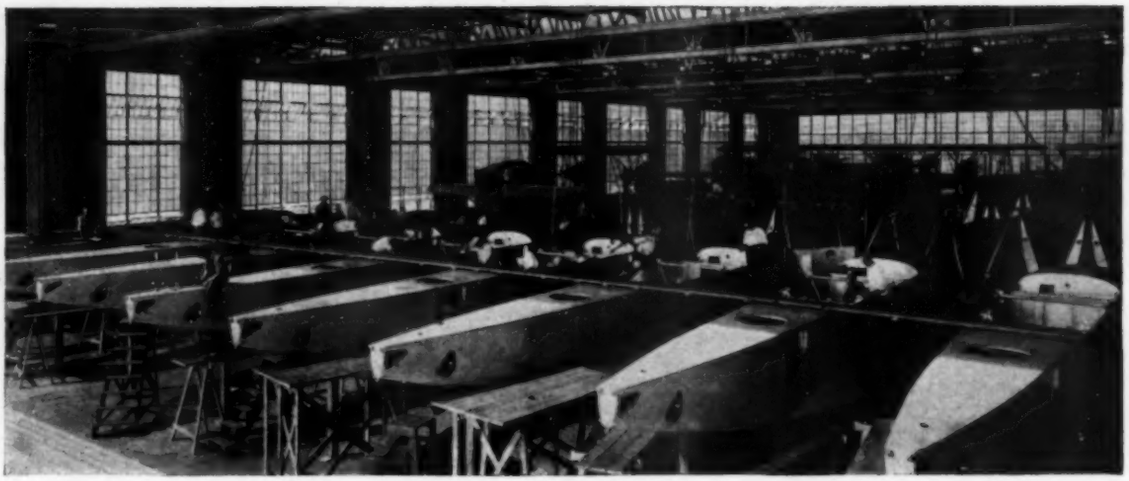
Gasoline storage from the safety standpoint is a problem anywhere, but here it is doubly so because we not only have to carry large quantities to service planes, but we have to fill tanks for testing purposes and then empty them. This means that in the case of airplanes shipped by rail, their tanks must be filled and emptied at least twice. This trouble, however, is more mental than physical. We make the same metal-to-metal connections on our gasoline connections that we make on our airplane fuel and oil lines and actually have no trouble.

A portion of each government contract is shipped by rail and water to Coco Solo, Hampton Roads, and San Diego. On a contract now going through the shop, three boxes are required for each plane. The dimensions of these are: 47 ft. 10 in. x 12 ft. 5 in. x 11 ft. high, 32 ft. 4 in. x 9 ft. 10½ in. x 10 ft. 11 in. high, and 20 ft. 4 in. x 6 ft. 5 in. x 11 ft. 2 in. high, a total of 10,057-cu.ft. displacement.

To provide facilities for crating and packing three such planes each week requires half as much space as is required for final assembly. One entire side of the department is a series of large doors that enables us to move and load these immense boxes on cars with very little trouble.

The warehouse in which the planes are packed contains the necessary equipment for doing the work. The sides, bottoms, and tops of the boxes, some of which weigh a ton, are made up and lined as units. The important part of the work, of course, is fastening the parts to prevent independent movement during transit. The monorail system extends into the warehouse and is utilized for the work done there.

Our entire plant, not the entire 1,200 acres, but the plant proper, is fenced. The exit to the flying field is



Midway on the assembly line

by means of a gate 130 ft. wide that is operated electrically on tracks set in concrete, by means of push buttons at the gate post and on the final assembly floor.

The final assembly floor is 1,750 ft. from the waters of Dark Head Creek. Between the two is a 20-ft. hard-surfaced road with a 20-ft. shoulder on each side. This road has a 2 per cent grade from the factory down to the water and under it. The landing ramp is 40 ft. wide by 140 ft. long and has nearly 6 ft. of water over its outer end at low tide.

The creek and Middle River, which at this place is an arm of Chesapeake Bay, affords protected water for taking off and landing, with broad open water just beyond. Ample sea room is afforded for anchoring sea planes on either side of the ramp.

One of our flying fields covers 900 acres and has two runways, one 3,850 ft. long, the other 2,450 ft. The width varies from 50 to 200 ft. The nearness of the bay and the fact that the entire field has a natural drainage toward it is a distinct asset. Instead of raising the foundations of our buildings, we have used a one per cent grade away from the factory in all directions.

INSPECTION

C. B. Hamlin

Chief Inspector

QUALITY in an airplane begins with the inspection and testing of the material as it is received. We use a large variety of materials, ranging from silk, linen, and cotton threads and cords, fabrics and rubber goods, through the various aluminum alloys, the brasses, and the bronzes, to the high-strength steel alloys. Each one is covered by a specification worked out by the engineering department to suit our special requirements.

Inspection with us is visual, dimensional, metallurgical, and chemical. The policy of taking no chances must perforce start with the inspection of raw material. One cannot purchase quality in lot; it must be selected from the mass either at the maker's factory through rigid specifications, or at our plant through rigid inspection.

Our methods largely follow those of other industries that maintain testing laboratories, but we probably test a larger percentage of any given lot for physical and chemical properties, and we also test materials that may not be thought sufficiently important to warrant test in other industries.

We not only use the coloration method of distinguishing and differentiating alloys of the same metal, but we also make this coloration a matter of inspection. In many instances, the lengths to which we go to eliminate chance would be considered as placing an unnecessary burden on the ultimate consumer, but where the dependence upon known quality is so vital, the procedure we follow is not only justifiable, but necessary.

Floor and machine inspection follows the usual routine, except that it is more exacting. These inspectors check the first piece and also succeeding pieces; it is not merely routine work.

Detail parts that can be easily handled are inspected in the detail inspection department, which is equipped with every kind of measuring instrument and fixture that can be of service.

We not only check up the heat-treatment of parts on a Rockwell hardness tester, but we also check the heat-treating furnaces at frequent intervals. This is unusual, but where the inspection force is part of the factory organization and reports to the factory manager, many things can be done that would be considered a reflection on the shop under other schemes of management. In this way, the efficiency of the shop and the quality of the product are increased, as is also the importance of the department as a whole.

A not inconsiderable part of the inspection work is checking weights. To catch these in time it is necessary to weigh the members of an assembly and also the complete assembly. In some cases even the welding may be enough overweight to affect the results. This welding is the process that turns the inspector's hair gray. Welding is a vital element, and there is no definite way of testing it short of destruction. The best that can be done is visual inspection and judgment, but both must be of a high order.

The inspection of hulls is equally important; the alignment of each member must be checked to assure a smooth

A 730-ft. loading platform does double duty as the roof of the power house

skin surface. Every rivet head, inside and out, must be individually inspected. To assure that every item is taken care of, a list of inspection points is furnished each inspector and he notes the results of his inspection and initials every item. The finish inspector is responsible for the finish to be applied. It has been found from experience that it is good practice to detail to this work one inspector who has made a study of the specifications for finish and the assembly procedure. This same man inspects fabric coverings and the finish applied thereto.

Final inspection does not present any difficult technical problem, but it must be performed by a man who notices details, because the omission of a cotter pin in one of the control units may wreck the plane. The flying qualities of a plane depend largely on perfect alignment of the wing and tail surfaces relative to each other and to the hull, and while the wing and tail structures and their mating parts have been carefully inspected throughout the manufacturing processes, we cannot be sure of the result until the straight edges and checking protractors say, "Well done."

FREE UNLOADING PLATFORM

THE "free unloading platform" is so called because the cost of the platform, the basement under it, and the heating equipment it contains about equals what it would cost to build a suitable power house for steam-heating the plant. In addition, we find that we have a lower maintenance and fuel cost.

At the north end of the platform, a ramp from the service drive gives direct access to the receiving department.

The railroad siding runs parallel to the platform. The south end adjoins the concrete apron in front of the final assembly doors, and serves for either side or end loading. A spur track 425 ft. long, parallel to the main siding on 16 ft. centers, permits the shifting of cars within the fenced area. A small platform 10 ft. wide and 100 ft. long extends from the south end, between the two tracks, thus permitting loading or unloading from both sides or ends of several cars at the same time.

RECEIVING AND STORING RAW MATERIALS

L. L. SOSENHEIMER
Chief of Stores

WHERE MUCH, if not all, of a product is manufactured on a time contract with a penalty on delay, it is important that the receiving, testing, and dispersing of raw materials be done promptly. All of our material is laboratory tested. Ten per cent of a given lot of metal is tested for all its chemical properties, and the rest of the same lot for at least one element. Like the doubting Thomas who, in watching a flock of sheep go by, would admit that each sheep had but one side sheared because he could not see the other, we deduce nothing, admit nothing. The bars in a given lot of metal may look alike, may even be alike, but we must *know* that they are alike.

After a preliminary visual and dimensional inspection, material is sent to the bonded storeroom where samples and test pieces are prepared for test. While the acceptance or rejection of material is a function of the inspection departments, it has no latitude outside of the engineering specifications. After acceptance, the metals are marked with their distinguishing colors in such a manner that they will be distinguishable even though the bars or sheets be cut several times.

Care must be taken to protect aluminum and aluminum alloys from corrosion and scratching. Therefore, immediately after the visual inspection, such alloys are oiled, marked, and repacked in original containers for storage. Bar stock and sheet steel is greased before being stored in permanent racks or bins. On some of the Duralumin bars and tubes, we use heavy rubber bands or rings to preserve them from even slight abrasions.

The perpetual inventory method is used to keep track of shortages and excesses. Postings are made daily and means are provided for indicating low stocks.

A fireproof building, separate from the factory, is used for the storage of inflammable items, and underground tanks for storing gasoline. We carry two kinds of the latter, motor gasoline for our cars and tractors, and airplane gasoline for testing purposes.

SANITATION AND HEATING

P. E. TIGNOR
Field Engineer

THE WATER SUPPLY and the sanitary layout are arranged for the convenience and comfort of the workman.

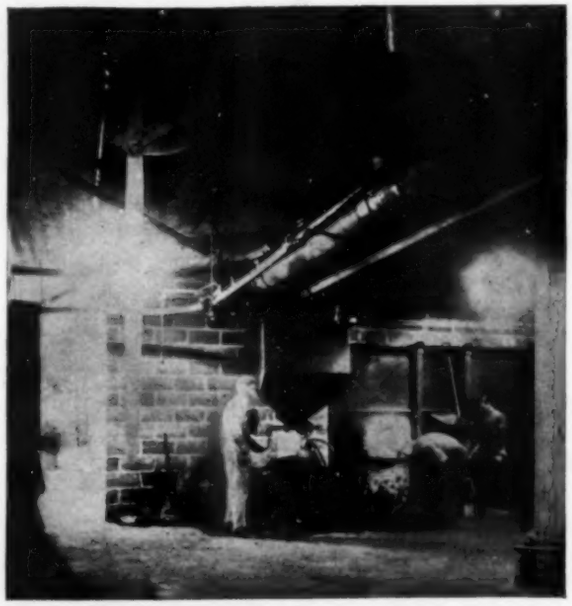
The cold water supply is taken direct from the Baltimore mains, and hot water is supplied from the steam plant. The storage heating tanks are capable of heating 900 gal. of water per hour from 40 to 180 deg. F., using steam at atmospheric pressure.

The hot water circulating pump connected in the system has a capacity of 35 gal. per minute against a net head of 40 ft. It is equipped with automatic starter and control.

The fire protection system consists of a wet pipe automatic sprinkler system and fire plug system. The automatic sprinklers are of the quartz bulb type and are set for 160 deg. F. generally. The system is fed by a 12-in. main direct from the city system, at 86 lb. pressure. A 1,000-gal.-per-minute pump was installed to boost this pressure to 125 lb., and to take a reserve of 110,000 gal. from the storage tank in case of emergency. The water storage tank is 58x36 ft. and 10 ft. deep, and is set half below the ground level. The sides and top serve as foundation walls and floor for the oil house in which all inflammable material is stored.

This type of underground tank was chosen instead of an upright steel tank to eliminate aviation hazards, for architectural reasons, and because of its dual capacity in serving as the oil house foundation.

A complete sewage system has been installed to meet the requirements of the Maryland State Board of Health.



Furnaces, fans, and electric equipment are all under the loading platform

All fixtures are trapped and vented. Toilet, wash fountain, and drinking water arrangements are such that any workman is within a 100-ft. radius of these units. This permits a minimum loss of time to each workman. Units, complete in themselves, are located on aisleways. Outside each enclosed toilet are two wash fountains of graniteware composition, 54 in. in diameter, with center spray, controlled for foot operation by a bar encircling the bowl. Each wash fountain is provided with a soap dispenser. The water supply to the fountains is tempered at each fountain by a thermostatically controlled mixing valve.

Each workman is given a metal locker in which he may keep his personal property. He provides his own lock, which gives him complete privacy. Each workman is also given clean towels semi-weekly, and a supply is always on hand for emergency purposes.

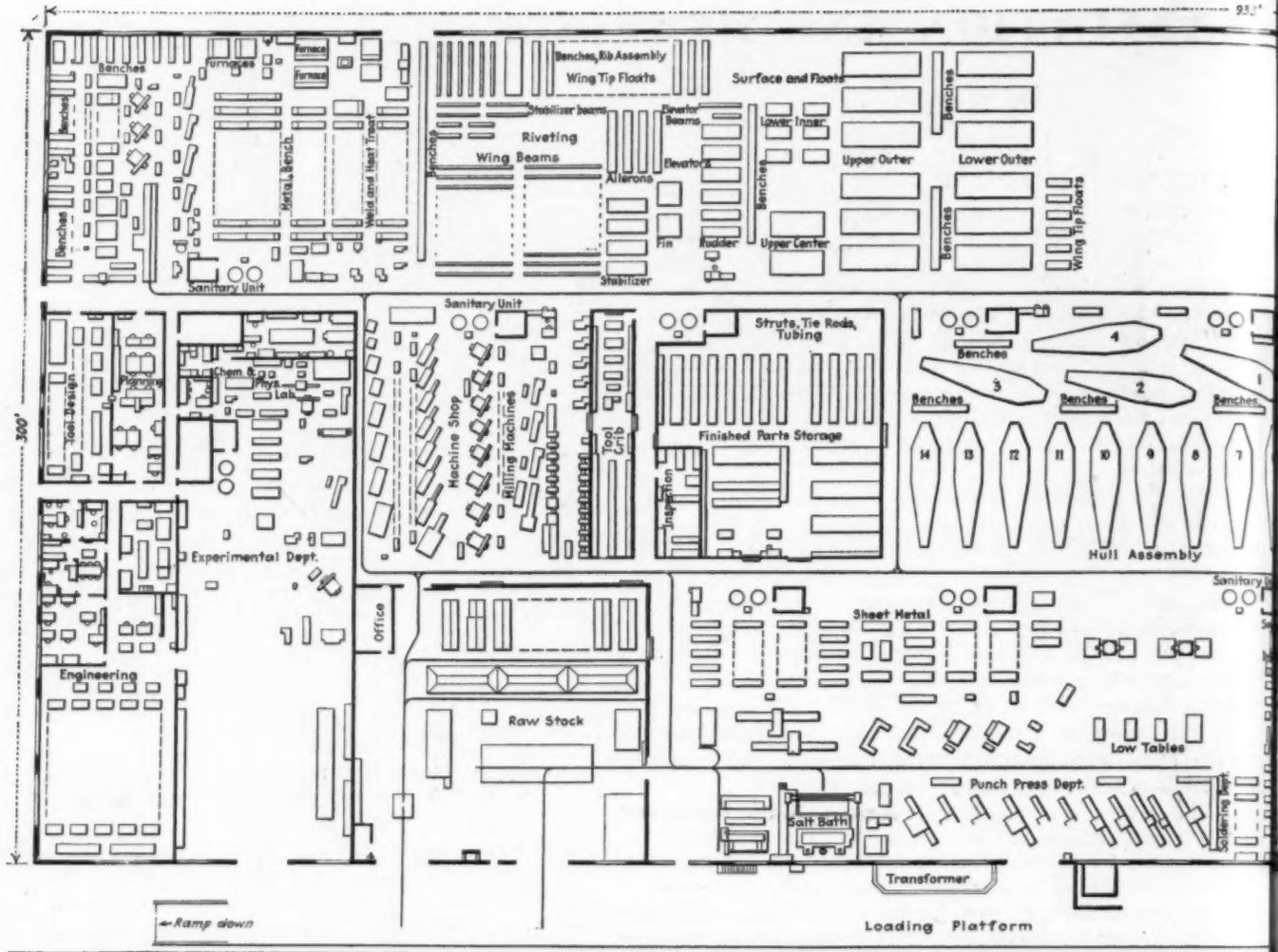
Because there was no sewage system in the Middle River district, and to meet up-to-date sanitary conditions, it was necessary to construct a sewage treatment plant. The sewage passes by gravity from the factory into the treatment works, and thence is finally discharged through an outfall sewer under water into Dark Head Creek.

The heating system for the factory and office building is located in the basement under the "free" unloading platform. Offices are heated by steam, the factory by Leif Lee direct air heating.

In this direct air heating system, heat is transferred from fire to air through one thickness of metal. The resistance to the transfer of heat from a metal wall to boiling water, usually through a layer of scale, and again, from condensing steam to a second metal wall through a layer of rust and oil, is eliminated. The heater and fans are enclosed in a separate room of cinder block. Thus, the air to be heated passes first over the outside of the furnace, receiving any heat lost by radiation. The air is drawn from the floor level, and reheated with a certain amount of outside air brought in through louvers.

The heated air from the furnace is distributed to the building by underground ducts, with mushroom outlets located along the walls or column bases or at the points where warmth is needed. Thus, the overhead space is kept clear. This direct distribution of hot air from the furnace to every part of the building, without the use of boilers, radiators, or unit heaters, makes for efficient operation; any practical amount of heat can be delivered when and where required. We have found in the operation of this system that there is no delay while steam is generated, but the heat starts as soon as the fire is lighted and the fans start. In mild weather, only the chill is taken off and the fire allowed to go out, thus saving the trouble and expense of banking the fire. However, it can be banked successfully and economically.

The system consists of 6 heaters distributed along the length of the building. Each heater has a capacity of 37,500 cu.ft. of air per minute or 3,750,000 B.t.u. per hour. Each heater is equipped with a two-speed motor. It was found necessary to use the high speed only in extremely cold weather. Each heater is equipped with a Westinghouse stoker having a capacity of 600 lb. of coal per hour. In summer this fan and duct system provide an excellent forced ventilation system to cool the plant, giving a complete change of air in the plant every twenty minutes. Thus the system serves a dual purpose without additional equipment or expense.



EQUIPMENT BY DEPARTMENTS

Accessories Under Platform

1—100 ft. Gardner Air Compressor.
1—Chicago Pneumatic 675 Ft. Air Compressor, OCE.
2—G.E. 20 KW. Hycycle Changer.
1—G.E. 12 volt, 1,000A Generator.
1—G.E. 60 volt, 1,000A Generator.
3—G.E. 500 KVA. Transformers.
3—G.E. 250 KVA. Lighting Transformers.
1—Size 1½ Gould Water Pump.
1—1,000 G.P.M. Worthington Fire Pump.
1—Size 1½ Gould Water Pump.

Cleaning & Plating

1—Type E Hanson, Van Winkle-Munning Plating Barrel.
1—Type 04 Hanson, Van Winkle-Munning Six-Barrel Machine.
2—Type CD 1 Pangborn Dust Arresters.
2—Type EN 2 Pangborn Sand Blast Cabinets.
1—Type CD Pangborn Dust Arrester.
1—Type CF Pangborn Sand Blast Barrel.
1—Hisey-Wolf Polish Stand.
2—G.L.M. Anodic Treatment System with G.E. Equipment.

Experimental Department

1—4E Niagara ¼ in. x 4 ft. Shear.
1—3A B. & S. Miller.
1—24 in. G. & E. Shaper.
1—14 in. x 10 ft. Monarch Lathe.
1—24 in. Cincinnati Drill Press.
2—Allen Drill Press 8 in. Overhang.
1—⅛ in. Gray Sheet Metal Rotary Shear.
1—No. 4 Atlas Arbor Press.
1—10 in. Cincinnati Emery Wheel Stand.
1—4 ft. Chicago Brake, Size 31.
1—8 in. Union Portable Jointer.
1—15 in. Syracuse Sander, Type D1.
1—V-36 Yates American Band Saw.
1—77 Whitney Novelty Saw.

Final Assembly

1—20 gal. Blackmer Portable Gas Pump.
1—50 gal. Blackmer Portable Water Pump.
1—50 gal. Invincible Vacuum Cleaner.
1—10 in. Cincinnati Emery Wheel Stand.
2—Fairbanks 10,000 lb. Portable Airplane Scales.

Finishing Department

1—Read G29 15 gal. Paint Mixer.
1—Singer Single Needle Sewing Machine.
1—Singer Double Needle Sewing Machine.
1—Eastman Circular Cutter, P976.
1—Durbrow & Hearne Pinking Machine.
2—20 ft. DeVilbiss, Spray Booths.
1—8 ft. DeVilbiss, Spray Booth.
1—5 ft. DeVilbiss, Spray Booth.

Laboratory

1—14 in. x 6 ft. Monarch Lathe.
1—No. 2B B. & S. Miller.
1—Allen Single Spindle Drill Press, 8 in. Overhang.
1—10 in. Cincinnati Emery Wheel Stand.
1—2 HS Sentry Furnace.
1—100,000 lb. Amsler Testing Machine.
1—20,000 lb. Amsler Testing Machine.

Machine Shop

1—3A B. & S. Miller.
3—2B B. & S. Miller.
2—3B B. & S. Miller.
1—Union Hand Miller.
1—14 in. x 6 ft. Monarch Lathe.
1—14 in. x 10 ft. Monarch Lathe.
1—18 in. x 8 ft. Monarch Lathe.
1—No. 3 Foster Screw Machine.
1—No. 2 Foster Screw Machine.
2—No. 5 Foster Screw Machine.
1—No. 2B Foster Screw Machine.
1—A-1¼ in. Cleveland Automatic Screw Machine.
1—A-¾ in. Cleveland Automatic Screw Machine, Single Spindle.
1—A-½ in. Cleveland Automatic Screw Machine, Single Spindle.
2—Allen single spindle Drill Press 8 in. Overhang.
1—Allen single spindle Drill Press, 12 in. Overhang.
6—Allen Double spindle Drill Press, 8 in. Overhang.
1—Allen Four spindle Drill Press, 8 in. Overhang.
3—Fosdick Four spindle 25 in. drill press.
2—H. S. Allen Single Sensitive Drill Press.
1—H. & G. Thread Machine.
2—Cincinnati 10 in. Emery Wheel Stands.
1—Atlas No. 4 Arbor Press.
1—Oil Conditioner System consisting of
1 Leon J. Barrett Extractor No. 5113.
1 Sharples Purifier Type OP-2 No. 3.
2 Gould Sump Pumps Size 1.

Maintenance Department

1—24 in. Cincinnati Drill Press.

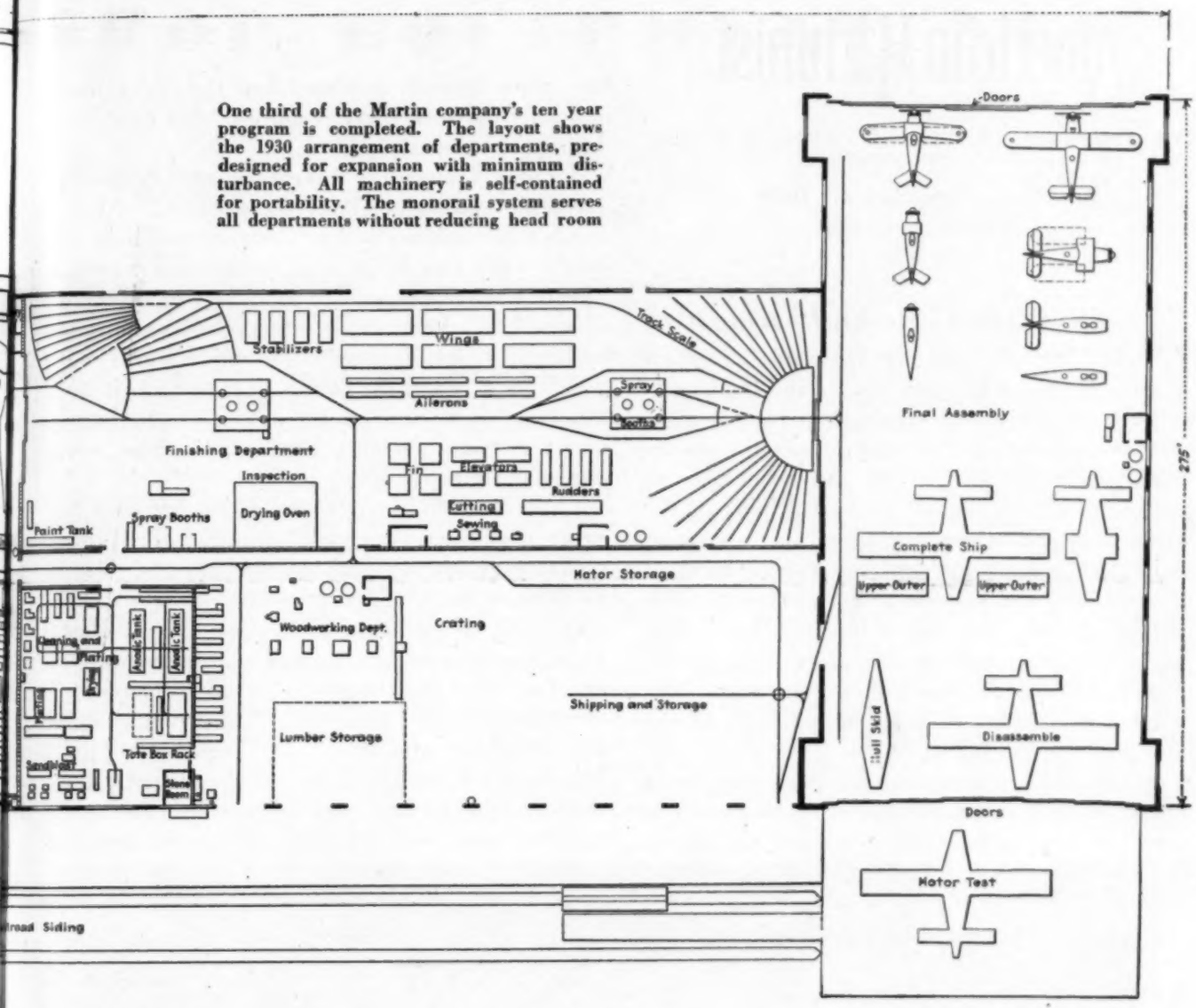
Metal Bench

1—No. 141 Besly Surface Grinder.
1—No. 30—3 ft. Chicago Brake.
1—No. 31—4 ft. Chicago Brake.
1—25 in. Fosdick Drill Press.
2—Allen Single Spindle Drill Press, 8 in. Overhang.
1—Cincinnati 10 in. Emery Wheel Stand.
1—Atlas No. 4 Arbor Press.

Heat-Treat. & Welding Department

1—Stewart Size 6 Type DDHS Gas Furnace.
1—4 ft. Strong, Carlisle & Hammond 4/S Elec. Furnace.
1—6 ft. Strong, Carlisle & Hammond 4/S Electric Furnace.

One third of the Martin company's ten year program is completed. The layout shows the 1930 arrangement of departments, predesigned for expansion with minimum disturbance. All machinery is self-contained for portability. The monorail system serves all departments without reducing head room



—Hauck Blacksmith Forge.
—"Homo" Electric Furnace, 22 in. dia. x 26 in. deep.

Raw Stores

—Peerless 9 in. H. S. Hacksaw.
—Universal 6 in. Shaping Saw.

Sheet Metal Department

—90 ton Bliss No. 8 Straight Side press.
—60 ton Bliss No. 23 Inclinable Press.
—50 ton Toledo No. 19 Deep Throat Press.
—30 ton Bliss No. 21 B Inclinable Press.
—15 ton Bliss No. 20G Inclinable Press.
—5 ton Bliss No. 18 Inclinable Press.
—500T—14 ft. Cincinnati Vertical Brake.
—100T—8 ft. Cincinnati Vertical Brake.
—No. 31—4 ft. Chicago Brake.
—¼ in. x 14 ft. Niagara Square Shear.
—¼ in. x 10½ ft. Niagara Square Shear.
—¼ in. x 4 ft. Niagara Square Shear.
—¼ in. x 4 ft. Niagara Square Shear.
—14 Ga. Quickwork Rotary Shear.
—¼ in. Gray-Campbell Nibbling Machine.
—Yoder Double Head Hammers.
—½ in. x 48 in. Newbold Roll Leveling Machine.
—⅛ in. x 48 in. Newbold Roll Leveling Machine.
—Niagara Power Beader.
—4 ft. Niagara Power Sliproll.
—Whitney No. 77 Miter Saw Table.
—Cincinnati 10 in. Emery Wheel Stand.
—American Monorail 20 ft. Electric Traveling Crane Hand Travel, Electric Hoist.
—Ryan Scully Gas-Fired Salt Bath Furnace 24 in. wide, 15 ft. 6 in. long, 4 ft. deep.
—Ryan Scully Gas-Fired Salt Pot 18 in. dia. x 24 in. deep.
—Radiac Type C cut-off Machine 1½ in.

Small Parts Assembly

1—Allen Single Spindle Drill Press—8 in. Overhang.
2—Allen Single Spindle Drill Press—12 in. Overhang.
1—Allen Single Spindle Sensitive Drill Press—8 in. Overhang.
1—2AHD "High Speed" Rivet Hammer.
1—3AHD "High Speed" Rivet Hammer.
1—Cincinnati 10 in. Emery Wheel Stand.
1—Riehlé Bros. 25,000 lb. 30 ft. Cable Test Machine.

Tool Crib

1—Oliver Drill Grinder ⅛ in. to 3 in. capacity.

Surface & Floats

2—Allen Single Spindle Drill Presses—12 in. Overhang.
2—8 in. Portable Novelty Saws.
1—Bliss 18S Bench Punch Press.
1—Allen Bench Drill—8 in. Overhang.
1—42U Tubular Rivet & Stud Co. Riveter.
1—Cincinnati 10 in. Emery Wheel Stand.
1—Martin built, Shape Bending Machine.

Tool Room

1—No. 3A B. & S. Miller.
2—No. 2B B. & S. Miller.
1—Model B Pratt & Whitney Vertical Shaper.
1—M-1278 Pratt & Whitney Jig Borer.
2—24 in. Cincinnati Shapers.
1—32 in. Cincinnati Shaper.
1—24 in. Gould & Eberhardt Shaper.
2—Oliver Filing Machines.
1—4 ft. x 16 ft. Gray Open Side Planer.
1—No. 3 Foster Screw Machine.
1—14 in. x 6 ft. Monarch Lathe.
1—14 in. x 10 ft. Monarch Lathe.
1—18 in. x 8 ft. Monarch Lathe.
1—12 in. x 3 ft. Greenfield Speed Lathe.
3—Allen Single Spindle Drill Press—8 in. Overhang.
1—Allen Single Spindle Drill Press—12 in. Overhang.
1—Fosdick 25 in. Drill Press.
1—No. 4 Atlas Arbor Press.
2—Cincinnati 10 in. Emery Wheel Stands.
1—Cincinnati Cylindrical Grinder, 12 in. x 3 ft.
1—No. 3 "Abrasive" Surface Grinder 8 in. x 24 in.
1—No. 1½ Cincinnati Tool & Cutter Grinder.
1—H. & G. "Eastern" Chaser Grinder.
1—FSB Biax Flexible Shaft Grinder.

Wood Shop

1—No. 24, Whitney Planer 32 in.
1—No. 1 Yates-American 12 in. Jointer.
1—G-44 Yates-American 18 in. Cut-Off Saw.
1—36 in. Yates-American Bandsaw.
1—Oliver 16 in. x 5 ft. Wood Lathe.
1—Allen Drill Press 12 in. Overhang.
1—Read Glue Mixer.
1—15 in. Syracuse Single Face Sander.
2—14 in. Whitney Novelty Miter Saws.
1—10 in. Cincinnati Emery Wheel Stand.
1—49B Covel-Hanchett Saw Filer.
1—83A Covel-Hanchett Saw Setter.
1—928 Covel-Hanchett Saw Grinder.

General Equipment

500—Chicago Pneumatic Hycycle Drill ⅛ in. to ½ in. capacity.
5—Universal Drills—Independent Tool Co.
272—Chicago Pneumatic Squeeze Riveters ½ in. x ⅜ in. capacity.
77—Chicago Pneumatic 5/32 in. Impact Hammers.
4—Chicago Pneumatic ⅜ in. Yoke Riveter.
175—Chicago Pneumatic Reciprocating Hammers.

American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

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VOL. 73 NO. 22

The Glenn L. Martin Development

ENCOURAGED by the favorable reception of the Allis-Chalmers tractor and the Chesapeake & Ohio railroad repair shop feature numbers, the editors of *American Machinist* are devoting the major part of the current number to an account of the unusual aircraft project of the Glenn L. Martin Company.

The Martin project with its twelve hundred acres of land and seaport is one of several large enterprises that have moved into the "short winter" zone. Generally speaking, two degrees of latitude toward the South mean one week later fall and one week earlier spring, and this advantage together with an ice-free port places this plant in a strategic position. It is becoming more and more apparent that large flying boats will be used for carrying commerce between the North and South Americas, and a seaport below the fog belt is an essential of success.

There has been no little speculation about the airplane industry. Will it become the industry of the next generation as the automobile is of this? Will it lead the way to better materials and better methods? Has it progressed far enough from the egg-crate and hay-wire stage to create a new market for metal-working equipment?

The various articles by the executives and heads of departments of the Martin organization give a clear picture of the progress in the past and the requirements of the present, while the company indicates its faith in the future of the industry by purchasing 1,200 acres of land and erecting the first unit of a definite ten year program.

Machine-Made Unemployment

WHETHER we call it technological unemployment or men thrown out of work by machinery the problem is the same, and it is serious. Surveys of the amount of unemployment from this cause may be interesting but they are of little value in finding the solution. And no matter how many men so displaced find their way into new lines of work there is more or less hardship during the transition period.

Tirades against the advent of new machines are futile and do not meet the situation. More and better machines will be designed and built to do the work now being done by men and women. The new machines will do laborious or monotonous tasks quicker and better than they can be done by hand. And ultimately the whole world will benefit as it has in the past. The problem is not the value of machinery, but how it can be introduced without involving hardship to those who can least afford it.

Captains of industry, whose genius has built up great businesses, can help greatly when they realize that this is a problem that must be solved by industry itself. Future benefits of the machine mean little to the man out of a job because of it. Logic has no appeal to the man who fears eviction or who cannot pay the grocer. And as a bankers' magazine recently remarked, "no civilization is safe when men who want work cannot find a job." Machines will not and cannot be abandoned. The world needs more of them and better. But management must find a way to bridge the gap between old jobs and new if it is to maintain industry in its present position. Unless it does find an acceptable solution, impractical and unpalatable legislative panaceas may result.

The Engineering Index

AT A recent meeting of its advisory board announcement was made that the Engineering Index is now on a self-sustaining basis. It may be some time, of course, before the original investment made by the American Society of Mechanical Engineers is recovered, but it is at least reassuring to learn that so specialized and technical a service is now so well recognized.

The Index is no new venture, but in its present form it is scarcely three years old. Some idea of its scope may be obtained from the statement that the editors secure fifty thousand index items each year from twelve hundred regular periodicals and half that many irregular ones, such as society transactions and research bulletins.

Many of us may have little occasion to look up engineering references, but it is comforting to know where we can find them whenever necessary.

SHOP EQUIPMENT NEWS

Gray "Ultra-Size" Planer

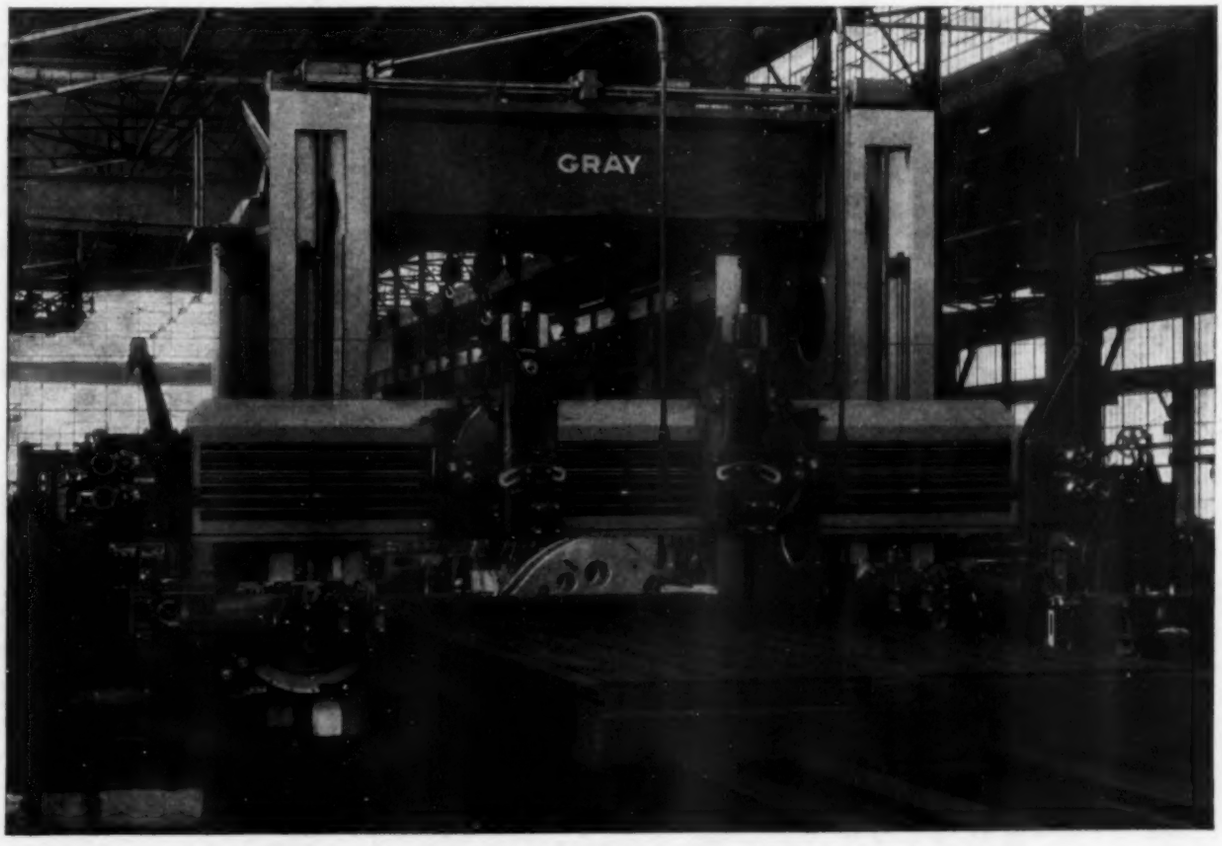
Refinement in design, ease and accuracy of tool setting and operation, with sufficient power and speed to utilize tungsten-carbide cutting tools to their capacity, are the outstanding features of the "Ultra-Size" planers announced by the G. A. Gray Company, Cincinnati, Ohio. The machine illustrated, which is the first so far built, has a capacity of 12 ft. in width, 10 ft. in height, and 30 ft. in length, the complete machine weighing half a million pounds. The cross-rail with the two heads weighs just over 40,000 lb., and the table weighs 120,000 lb.

Among the design features that differ from usual practice are: four ways, two V's and two flats; three rows of leveling screws, one being in the center of the bed and accessible from the top; a steel camber beam attached to the top of the rail to insure a straight cut as the head travels across the rail; each head on the cross-rail supported by two hardened rollers mounted on ball bearings, instead of having the load come on the upper gib; over counter-balancing of all heads to take up lost motion at all times; automatic centering of supports for all cross-rail screws and feed rods; complete interlocking control of all movements from either side of the planer and at the tool heads; the use of electric motors to lock and unlock the rail to the housing, these being automatically timed with the motors that elevate the rail.

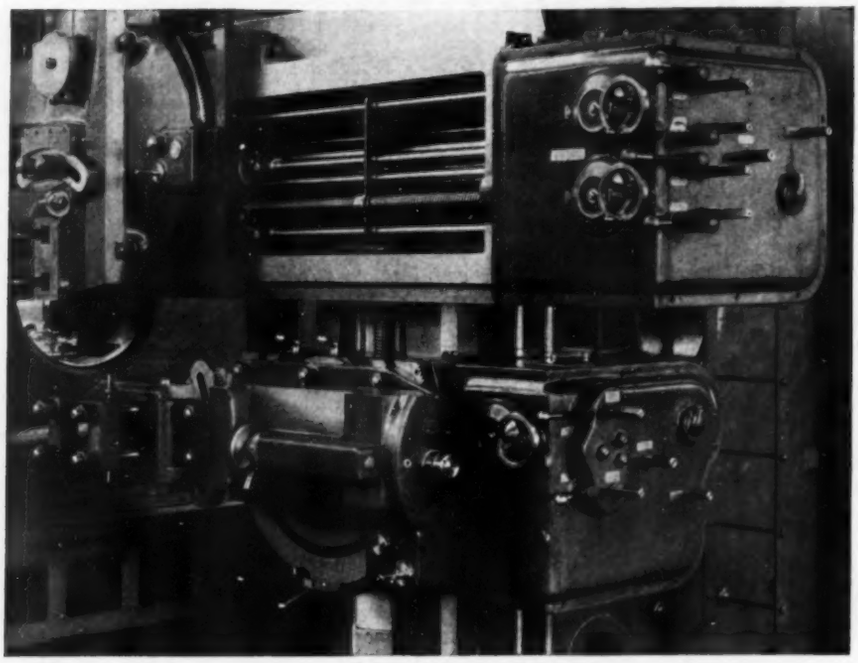
The controls enable an operator to set the tool rapidly and accurately to gage without a helper. He can use rapid traverse and handle the final setting by hand movement with little effort because of the liberal use of anti-friction bearings. The use of 407 ball and roller bearings of seven different types show to what extent the bearing problems were studied.

The use of four ways prevents deflection of the table and the V-guides each side of the rack eliminate the tendency to cock. These V's are also close enough together to prevent their being affected by temperature changes. The combined area of the ways gives a very low pressure with a normal load. In fact, with the maximum load of a cast-iron block 10 ft. sq. by 30 ft. long, weighing 1,300,000 lb., the bearing pressure would not exceed 100 lb. per sq.in.

Twin helical gearing of forged steel is used, as in the company's frog and switch planers, every gear in the driving train including the bull gear and table rack being of the helical type. The gear train is calculated to transmit 75 hp. and to give table speeds from 20 to 120 ft. per min., together with independently variable table return speeds covering the same range. The design contemplates and prepares for cutting speeds much higher than any now in use. This



Gray "Ultra Size" 12x10x30-Ft. Planer, showing new pendant push-button controls



Gear boxes and tool heads on the crossrail and the side of the housing

planer has a 75 hp. 200-1,200 r.p.m. G. E. reversing motor, and will give cutting speeds from 20 to 120 ft. per min.

Two independent geared pumps supply oil through independent filters to a common discharge, from which it goes to the main and supplementary oil grooves that insure ample oiling regardless of the length of the stroke.

Rail control is simple and unusual. Pressing either of the buttons marked "raise" or "lower" starts two-small motors to unclamp the rail at each housing. When the rail is free to move, the elevating motor starts and performs its function. Releasing the button stops the elevating motor and then runs the clamping motor until the rail is secure.

The four tool heads are of novel design, either head being controlled from either end of the rail or from the head itself. At each end of the rail is a large gearbox in which is the power rapid traverse mechanism for the head on that end. Both of the heads can, however, be controlled from either end of the rail.

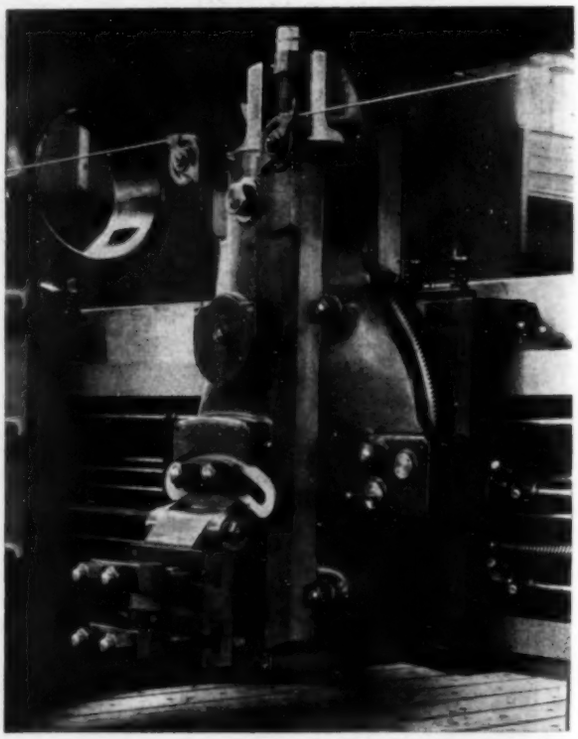
The weight of the head on the rail is carried by spring mounted, ball bearing rollers so that the upper gib merely acts as a guide. Each gearbox has two handwheels and two dials. The lower wheels adjust the feed of the right-hand rail head on either box, the amount of feed being shown by the lower dials. In the same way the upper wheels and dials at either end, adjust and indicate the feed for the left-hand rail, giving complete control from either side. In a similar manner, the movement of the slide in either head can be controlled by the handles at the end of each gearbox. All the feed and rapid traverse trains have safety clutches that slip and warn the operator of interference, thus preventing damage.

Hand cranks are provided for moving the heads on the rail but are seldom used. These cranks do not revolve when the rapid traverse is in operation. Four control shafts in front of the rail are splined for hubs which travel with the saddle, these hubs having removable handles. By placing the handle on the proper hub, the operator can engage any feed or secure any desired movement of the head or tool slide by hand. Ratchets near these hubs enable the operator to "inch" the saddle at will. Both control hubs and ratchets being close to the tool makes it easy to set the tools on the work.

The swivel of the "harp" that carries the tool slide, covers the greater part of the front of the saddle. When clamped by the six large bolts, it is exceptionally stiff to resist both twisting and bending strains. The swivel is operated by a worm and gear mounted on ball and roller bearings in a box packed with grease. The tool box is also swiveled by a worm and sector. Each tool box apron or clapper is automatically lifted by a positive mechanical lifter concealed within the box itself, but can be cut out of action when desired.

The side heads have the same range and capacity as the rail heads, the slide feed being 36 in. Each side head has its own feed, independent of the rail feeds, adjustable by hand and read by a dial. Control handles are located at the top, and bottom so as to be accessible regardless of the operator's position.

Such large planers are often used for breakdown service, where the part worked upon is an essential element of a plant running into huge sums. The planer illustrated is cheap insurance, even though it is seldom used.



Head on crossrail, showing springs over the rollers that support the load. Hollow-head capscrews add to the appearance

Cincinnati 34x192-In. Roll Grinder

Designed for grinding barrels and journals of both parallel and cambered rolls, the roll grinders being announced by Cincinnati Grinders Incorporated, Cincinnati, Ohio, embody a number of unique features. One of these machines, a 34x192-in. grinder has recently been installed for grinding both parallel and cambered rolls, these rolls having journals arranged for both plain bearings and anti-friction bearings.

The general arrangement of this grinder is shown in the front elevation Fig. 1, and in the plan view, Fig. 2. This latter illustration indicates that the tool is of the traversing table type. All motions are motor driven, five motors being employed as follows: one 10-hp. variable-speed motor for work rotation; one 30-hp. constant-speed motor for the drive to the grinding wheel spindle; a 5-hp. constant-speed motor for driving the feed box operating the table traversing mechanism; a 1-hp. constant-speed motor for the rapid traverse mechanism for the grinding wheelhead; and a ½-hp. vertically mounted, constant-speed motor for driving the vertical centrifugal pump used to circulate the coolant supply.

The outstandingly features of this machine are: the centralized control that enables the operator to exercise complete control over all functions from one small platform; and the simple and flexible cambering mechanism, which enables rolls to be contoured.

Because rolls mounted on anti-friction bearings have roll necks which are tapered, it was necessary to equip the machine with a swiveling top table, which can be rapidly and securely set over for grinding this taper.

Special mounting blocks fitted to the table are used on this machine to enable rolls once fitted up with anti-friction bearings to be ground on the roll barrel without removing the anti-friction bearings from the roll. The axis of rotation, therefore, is maintained during the grinding operation in a way which is a duplicate of the actual operating condition of the roll in the mill.

All the usual conveniences of operation are provided on this tool, including hand operated rheostat control to the work rotation speed, push button start and stop switches for all motors, selective speed changing with one lever for all table traverse speeds, micrometer in-feed control to the grinding wheel, with an auxiliary rapid traverse mechanism for rapidly positioning the grinding wheel when changing from one major diameter to another. The handwheel controlling the motion of the footstock barrel is so placed that the operator can stand close to the work and guide it on to the center.

All of the larger sizes of rolls, of course, are ground with the roll resting upon its journals, but the machine is so arranged that it will efficiently handle small diameter rolls, and it is in conjunction with work of this kind that the small items of operating convenience are useful.

It will be seen from Fig. 3 that the footstock carries the radius truing device for rounding the corners of the grinding wheel when grinding the fillets in the roll ends, and although not visible, the footstock also carries the wheel face crowning equipment which is used when grinding rolls of concave contour. An anti-friction type stop mounted in the center hole is used when rolls are being ground on journals. The footstock, as well as the headstock, is equipped with a lever and pawl arrangement, the latter engaging on the top of the table to eliminate creepage of either the headstock or footstock, and triple acting clamps hold these units rigidly in position on the table. The table traversing mechanism is of the regular Cincinnati design.

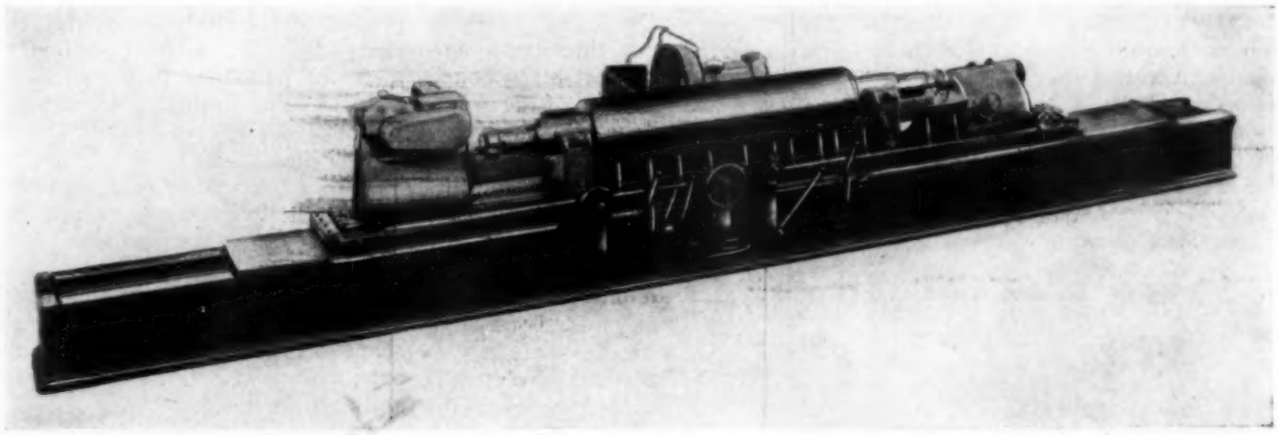


Fig. 1—Cincinnati 34x192-In. Roll Grinder for the production of both parallel and cambered rolls

Fig. 4 shows the general arrangement of the main drive for the grinding wheelhead. The spindle is mounted on preloaded SKF bearings. Drive from the jackshaft to the grinding wheel spindle is obtained by means of a Morse silent chain. The slack side of the chain is steadied by means of a large cast-iron shoe with a curved contact surface. Fig. 4 also shows the general arrangement of the cambering mechanism and the point about which it pivots.

Roll cambers are influenced by some of the following factors: roll diameter; roll material; the hardness of this material and its modulus of elasticity. While these factors are fairly reliable subjects for calculation, it has been found impossible to estimate accurately the necessary

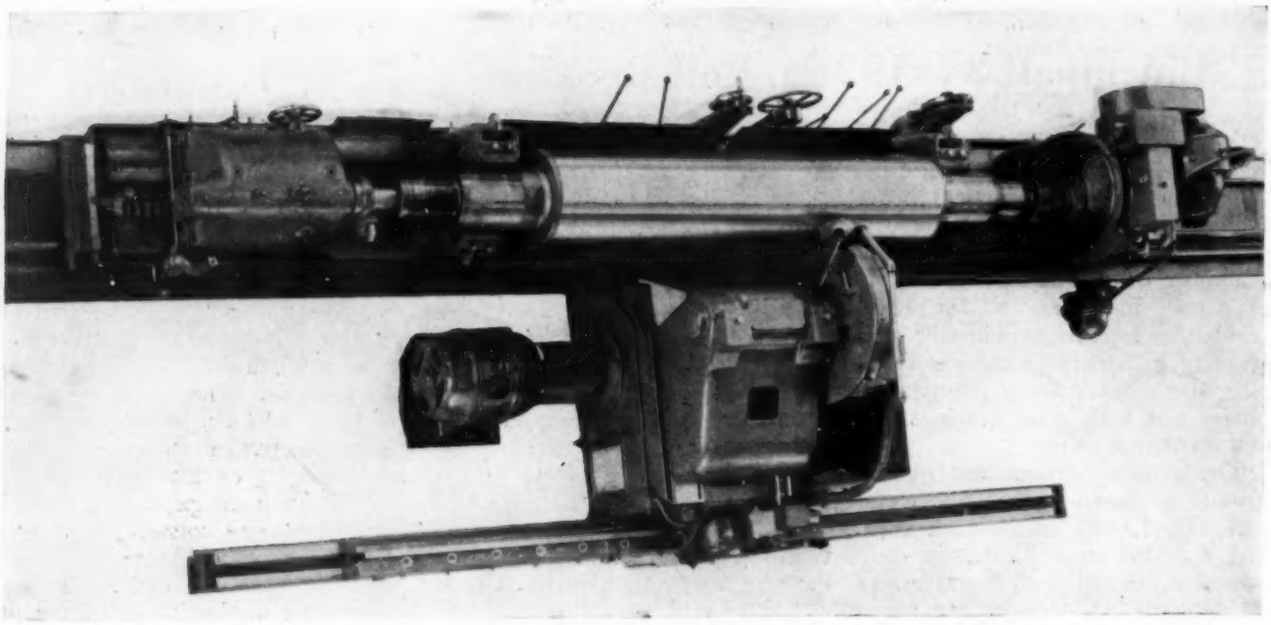


Fig. 2—Plan view of Cincinnati 34x192-In. Roll Grinder, showing the traversing table

amount of compensation to allow in roll contours for such variables as change in temperature of the material being rolled, viscosity of the oil used to lubricate the rolling mill, the spring of the mill under varying loads, and the amount of reduction on the rolled material passed through the rolls. There is a growing demand for a

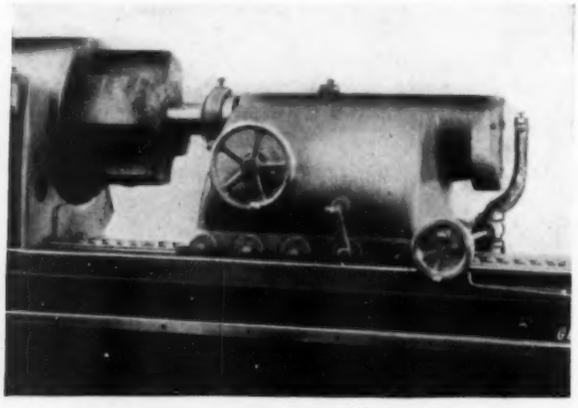


Fig. 3—The footstock carries a radius truing device for rounding the corners of the grinding wheel when grinding fillets in the roll ends

camber mechanism that will enable contours to be produced on the roll surface where the variables mentioned above are such that they interfere with the production of accurately thicknessed sheets.

It was with a view to meeting these special and exacting requirements that the camber mechanism shown in Fig. 4 was produced. This mechanism consists essentially of an auxiliary bracket carried on a three-point support, the center support being bolted securely to the rear base of the grinding machine and the two outer feet resting on wedge blocks on the shop floor. A carriage is mounted on this machined base, and is somewhat longer than the maximum length of roll surface to be ground.

By means of a large diameter shaft, a synchronized movement is obtained between the carriage and the roll grinder table carrying the work. Cambering of the roll surface is obtained by means of tilting the grinding wheelhead at the pivotal point marked *A* on Fig. 4. Swing of the grinding wheelhead and its supporting base is controlled accurately by means of the camber bar carried in the sliding carriage. Contact between the camber bar and sub-base of the grinding wheelhead is obtained by means of a bronze-faced shoe bolted to the rear of the wheelhead sub-base.

The camber bar itself, from which the contour is obtained, can be of either a permanent form or, as shown in Fig. 4, can be made from a parallel deep-section bar of hardened and ground steel which is sprung and clamped in the sprung position to meet the particular requirements of the roll being ground. An accurate indicator device reading in 0.0001 in. is embodied.

With a camber bar equal in length to the roll surface to be ground and operated through a massive lever mechanism with a ratio of decrease of 1½ to 1, the operator is provided with means for accurately reproducing the shape dictated by experience with the particular rolling mill for which the rolls are intended.

Drive from the grinding machine table traversing mechanism to the carriage of the camber mechanism is

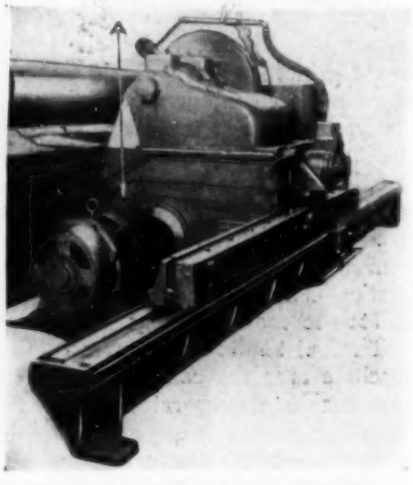


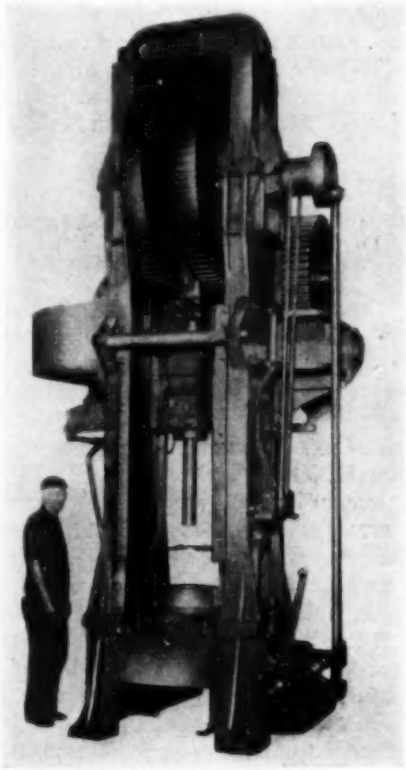
Fig. 4—Cambering a roll is done by tilting the wheelhead about the pivotal point *A*

powerful and accurate, and smoothness of motion is obtained by the force-feeding lubricating system used on the cambering mechanism, which is a duplicate of that which is used on the main table of the machine.

Bliss No. 906 Long-Stroke Reducing Press

For redrawing long brass, copper or aluminum shells at high speed, the E. W. Bliss Company, Brooklyn, N. Y., announces the No. 906 long-stroke reducing press with balanced gear drive. It has a 36-in. stroke and operates at 18 strokes per minute.

Brass, copper and aluminum can be drawn at much faster speeds than the rack and pinion or hydraulic presses can operate. In a regular crank-type press, on relatively short stroke work brass has been drawn at the rate of 200 ft. per min. Rack and pinion presses may reach a maximum drawing speed of 12 to 36 ft. per min. and an operating speed of one to three strokes per minute. The drawing speed of the press illustrated is 170 ft. per min. at 18 strokes per minute. This is from five to ten times as fast as the rack and pinion machine and compares favorably with the best modern practice in drawing brass in crank presses as mentioned above.



Bliss No. 906 Long-Stroke Reducing Press for redrawing brass, copper and aluminum shells at the rate of 170 ft. per min. at 18 strokes per minute

Regular crank-type presses with strokes up to 20 in. have been used on long draws, but if longer stroke presses of the regular crank type are used, the shaft would have to be much larger than necessary for the work, because of the excessive twisting moment set up in the shaft by the long throw of the crank. Thus, such a press would have to be about twice as heavy as the machine illustrated, and could not operate half as fast.

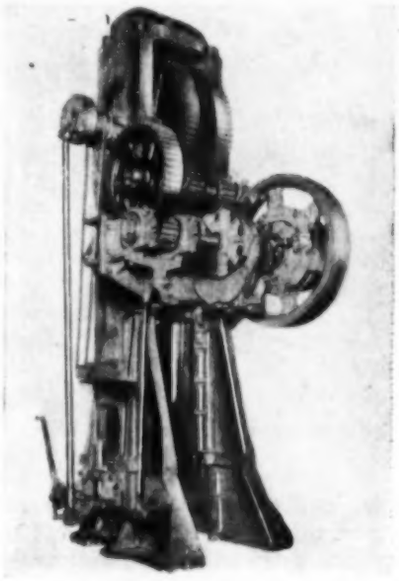
In the No. 906 reducing press, the twisting moment of the crankshaft is entirely eliminated by applying the driving power to the point where the cheeks would be on a regular crankshaft. In place of the cranks, two large steel gears are connected by a crankpin 18 in. from the center line of the twin gears. These gears are force fitted to journals that rotate in long bronze-bushed bearings at the point where the regular crank bearings would ordinarily be mounted. With torsion removed, the crankpin and main journals do not have to be oversized. A solid, one-piece double pinion drives the twin gears from a backshaft. For smoother engagement, the two units of the gear train are out of step by one-half a tooth pitch.

Built-up frame construction is used in this press, with shrunk-in tie rods, double gearing, and a full automatic friction clutch with both foot and hand lever control, so that the press may be operated by hand in setting and testing dies. The clutch is arranged so that the slide can be stopped or started at any point of the stroke independently of the full automatic mechanism.

Timken roller bearings carry the driveshaft and friction clutch. The crankpin and other journal bearings are fitted with removable bronze bushings. A mechanical force-feed lubricator is furnished with separate piping to all bearing surfaces. A smaller mechanical lubricator is mounted directly on the slide for the crankpin and wristpin bearings.

Since in drawing operations, the work is being done over a comparatively long period of the cycle—often practically from midstroke to bottom stroke—a 2,300 lb. flywheel is employed.

The principal specifications are as follows: weight of press, 41,000 lb.; adjustment of slide, 4 in.; distance, bed to slide, stroke down, adjustment up, 16 in.; diameter of shaft, at bearings, 6 in., at crankshaft, 7 in.; capacity of press at midstroke, 15 tons;



Rear view of Bliss No. 906 Press, showing the double gearing

width between uprights, 24 in.; width between gibs, 23 in.; area, top of bolster F. & B. x R. & L., 26x23 in.; thickness of bolster, 3 in.; area, face of slide F. & B. x R. & L., 14½ x 23 in.; opening in bed, 8¼ in. in diameter; floor space overall, 90½ x 99 in.; motor recommended, 40 hp., 900 r.p.m.

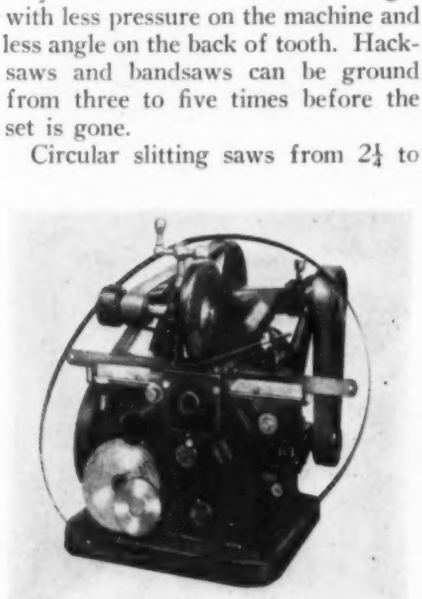
With the direct geared crank design mentioned above, presses with strokes even longer than 36 in. are made practical. Press speeds of 12 strokes per minute with a 60-in. stroke and ten strokes per minute with a 72-in. stroke are obtainable.

Porter No. 00 Saw Grinder

Hacksaws, bandsaws, and circular saws can all be sharpened on the No. 00 saw grinder announced by the J. E. Porter Machine Company, 1872 Jefferson St., Muskegon, Mich. Hacksaws and bandsaws do not have

the decarbonized surface caused by the hardening process removed by grinding, but obviously if ground, they will cut faster and last longer with less pressure on the machine and less angle on the back of tooth. Hacksaws and bandsaws can be ground from three to five times before the set is gone.

Circular slitting saws from 2¼ to



Porter No. 00 Saw Grinder for circular saws, bandsaws, and hacksaws

5 in. in diameter with teeth from 4 per in. to the finest with a hole ¾ in. and larger can be ground, and smaller than ¾ in. as special. The machine will also grind six saws each 1/32 in. thick at one time, or saws of other thicknesses totaling approximately 3/16 in. Power hacksaw blades in any width up to 1½ in., with 4 teeth to the inch and finer, and any length can also be sharpened.

Another model is available to sharpen both hacksaws and bandsaws, but not circular saws, whereas the third is for circular saws only. Bench space required is 15 by 21 in. Shipping weight is 190 lb.

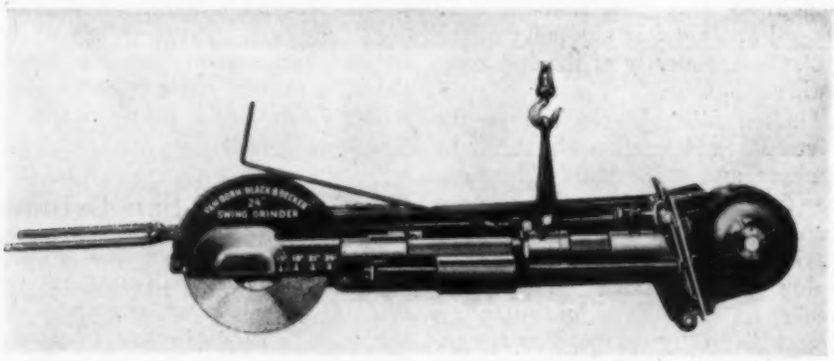
Monitor Ironclad Push-Button Switch

For momentary contact control, especially on machine service, the Monitor Controller Company, Baltimore, Md., has designed an ironclad push-button switch for a.c. or d.c. circuits. Features of this switch include quick-action inching, massive and flexible contacts, and buttons located for safety. The stop button is on the top, fully exposed and easy

Monitor Ironclad Push-Button Switch for a.c. or d.c. circuits

to operate. The start button is placed below and fully protected from accidental contact. The switch is both drip- and splash-proof.

The switch consists of two parts: (1) the base which carries the wiring and fixed contacts, and (2) the cover carrying the buttons. Conduit connections can be made from top, bottom, or sides. The over-all height is 4¼ in., width, 2 1/16 in., and depth from mount 2⅝ in.



Black & Decker Multi-Speed Swing-Frame Grinder, which has the wheel guard arranged to make speed changes

Federal Light-Duty Spot Welder for 16 to 30 gage

Federal Light-Duty Spot Welders

Throat depths from 6 to 12 in., and capacities from 5 to 7½ kw. are available in the line of light-duty spot welders placed on the market by The Federal Machine & Welder Company, Dana Ave., Warren, Ohio. These welders are supplied with six-point heat control to allow welding from 30 to 16 gage on the same equipment. Either water-cooled horns and points or solid horns and points can be had.

Black & Decker Multi-Speed Swing-Frame Grinder

Three speed changes can be had in the swing-frame grinder announced by the Black & Decker Manufacturing Company, Towson, Md. Maximum wheel sizes are 12, 16, 18, 20, and 24 in., and the wheel speeds range from 6,000 to 9,000 s.f.p.m.

The adjustable steel wheel guard is arranged to make the various speed changes. As the wheel wears, the guard is moved back the proper distance, thus causing the changes in speed to be made. Provided with the guard is an arrangement that prevents the operator from failing to make the speed changes as the wheels wear. Also, there is supplied a visual device which shows at a glance whether or not proper guard and speed changes have been made. A heavy-duty, ball-bearing motor is supplied with the grinder.

Monarch-Keller Form Turning Lathes

For turning or facing special shapes in any form for which a thin master template can be made, the Monarch Machine Tool Company, Sidney, Ohio, is introducing the "Monarch-Keller" form turning lathes. These machines are suitable for the rapid and economical production of die-casting dies, glass bottle molds, can forming dies, spinning chucks, punches and dies for hollow ware, composition mold dies, mill rolls of various shapes, sheet metal bending rolls, and many others. The lathes are made possible by the application of the electrical controls manufactured by the Keller Mechanical Engineering Corporation.

A control unit consists of three main parts: A standard Keller tracer, two Keller magnet boxes, and a control cabinet. The contact points of the tracer are protected by a cover.

The illustration shows how the tracer is mounted in a bracket, in a fixed relation to the cutting tool. The front Keller magnet box is geared to the feed rod of the lathe. When the machine is operating, the cross feed friction remains engaged—giving automatic cross travel in either direction to the tool slide. The rear Keller magnet box is geared to the leadscrew of the lathe. Length travel to the carriage and tool slide is automatically imparted as the apron half-nut remains engaged with the leadscrew. Any desired feeding rate for either cross or length feed can be instantly secured by the electric rheostats.

The Keller control cabinet is conveniently placed for the operator so that the directional controls are within easy reach. The two rheostat control knobs on the control unit provide 96 changes of feed for both length and cross feeds.

A thin metal template, easily made of sheet steel, zinc, brass or other metal, is mounted on a bracket at the back of the lathe, parallel to either the longitudinal or cross feed—depending upon the position of work in the lathe, whether between centers or on the face plate.

Work can be automatically formed on the lathe to the full swing capacity of the lathe, and to the full length between centers.

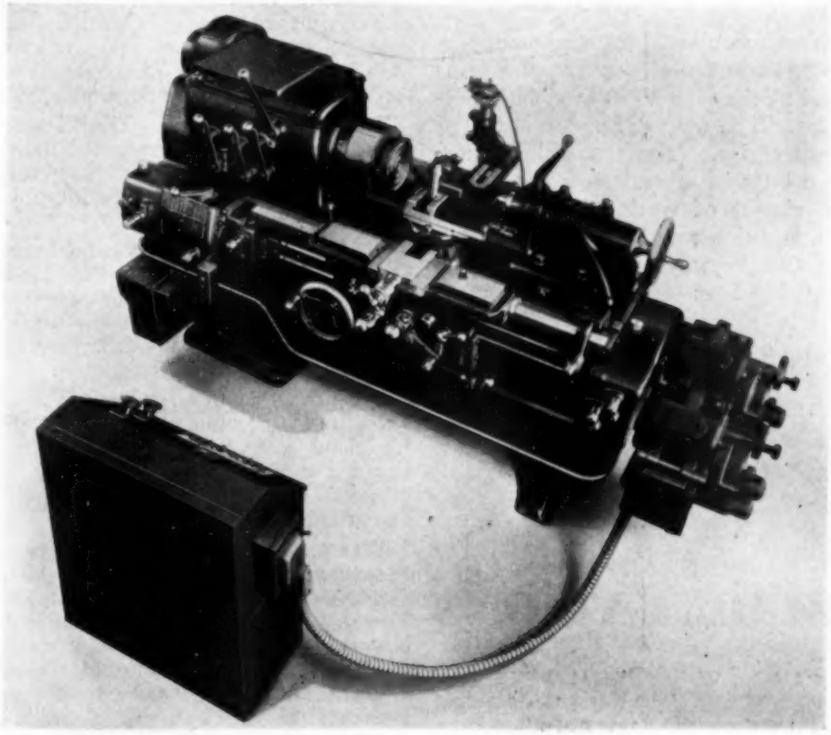
The "Monarch-Keller" automatic form turning lathe combines two machines in one—a standard engine lathe and an automatic form turning lathe.

The quick-change gear box of the lathe as well as the end gearing do not operate when the lathe is being used for automatic form turning. By changing the position of three levers, the quick change gear box is engaged and the Keller units disconnected from the driving units of the lathe so that the lathe can be used for ordinary lathe work.

Although the contact of the tracer with the template is very light, the control is positive, so that the depth of cut is in no way dependent on the pressure exerted against the template. The Keller controls do not affect the stock removing capacity of the lathe. Heavy cuts can be taken, in form turning, with a lathe under Keller control, in the same way as they are taken on a standard lathe not so equipped. The same amount of stock may be removed in a given time either with or without the control—limited only by the rigidity of the tool and the power factor.

The Keller controls are extremely accurate and will duplicate the master template to limits as close as 0.001 in. Most form turning jobs can be completed more quickly, more accurately and more economically on a Monarch-Keller form turning lathe than by the ordinary method of hand feeding.

The Keller automatic control can be applied to all types of Monarch helical-geared Timkenized lathes, on all sizes from 14 to 36 in. swing. The control must be mounted and wired at the factory. It is a built-in feature and cannot well be applied to lathes now in use.



Monarch-Keller Form Turning Lathe, showing the control cabinet in the foreground and the tracer bracket mounted at the back of the machine, while the gearboxes are at the end for cross travel and length travel of the tool slide

PATENTS

NOVEMBER 18, 1930

Metal-Working Machinery

Lathe-Oiling Mechanism. William F. Groene, Cincinnati, Ohio, assigned to R. K. Le Blond Machine Tool Co. *Patent 1,178,754.*

Machine for Making Wire Strands, Ropes, and Cables. Edward A. Conner, Stratford, Conn., assigned to American Cable Co. *Patent 1,781,894.*

Multiple-Mixture Die-Casting Method

and Machine. Axel Akers, Chicago, Ill., assigned to Quality Hardware & Machine Corporation. *Patent 1,781,939.*

Bearing Grooving and Pocketing Machine. Clifford T. Sondley, Newberry, S. C. *Patent 1,782,104.*

Machine-Tool Organization. Edward J. Kearney, Wauwatosa, and Joseph B. Armitage, Milwaukee, Wis., assigned to Kearney & Trecker Corporation. *Patent 1,782,235.*

Pressure Die-Casting Appliance. Karl Friedrich Wagner, Feuerbach, near Stuttgart, Germany, assigned to Elektronmetall G. m. b. H., Cannstatt-Stuttgart, Germany. *Patent 1,782,248.*

Molding Machine. Albert William Sizer, Hessel, England. *Patent 1,782,322.*

Tools and Attachments

Chuck. Schuyler H. Earl, Rochester, N. Y., assigned to Gleason Works. *Patent 1,781,721.*

Cylinder Honing Device. Frederick C. Moser, East Brook, Pa. *Patent 1,781,856.*

Automatic Loading Device. Felix Hamrol, Detroit, Mich., assigned to Motor City Sales Co. *Patent 1,781,873.*

Diestock. Thorvald Petersen, Erie, Pa., assigned to Reed Manufacturing Co. *Patent 1,781,932.*

Diestock. Leo. V. Stoeltzlen, Erie, Pa., assigned to Reed Manufacturing Co. *Patent 1,781,936.*

Lathe Center. Lewis R. Power, Lawton, Mich. *Patent 1,782,272.*

Furnaces

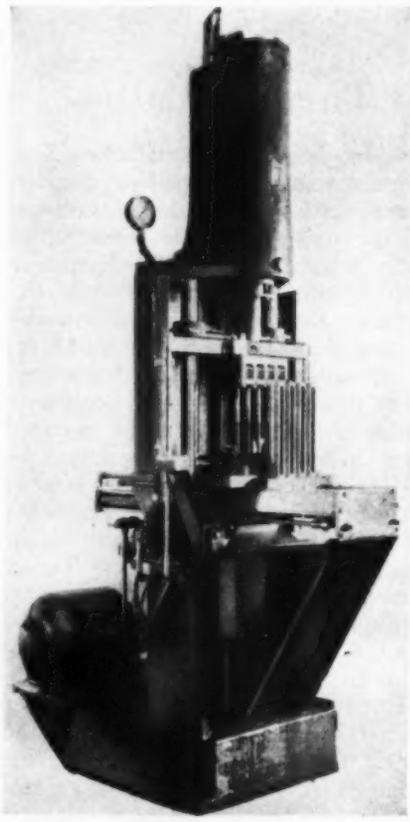
Furnace Conveyor. George F. Beach, Philadelphia, Pa., assigned to Ryan, Scully & Co. *Patent 1,782,335.*

Processes

Method of Welding. Boris S. Robinoff, Pittsburgh, Pa., and Sumner E. Paine and Wrignol E. Quillen, McKeesport, Pa., assigned to National Tube Co. *Patent 1,782,316.*

American V-18 Full-Automatic Broaching Machine with Magazine Feed

Four parts at a time are broached on the V-18 full-automatic broaching machine developed by the American Broach & Machine Company, Ann Arbor, Mich. The parts in question are bevel differential pinions, and the operation consists of removing 0.020 on the $\frac{7}{8}$-in. bore of the pinions. The magazine can be fed manually or by means of a conveyor or hopper. The complete cycle of broaching four parts at a time is made every 8 sec., giving a production of 30 pieces per minute.



American Type V-18 Full Automatic Broaching Machine arranged for magazine feeding of four bevel differential pinions at each cycle of 8 seconds

This machine is fully automatic in operation and works on the same principal as the type V-50 broaching machine. The only difference is in the smaller size. These machines have been built in several sizes for different classes of work. For example, one machine was built for broaching out two keyways in a tapered hole. The keyways are placed approximately 100 degrees apart, were $\frac{3}{16}$ in. wide and the hole at the small end was $\frac{3}{4}$ in. The work was $1\frac{1}{2}$ in. long, and made of malleable iron. On work of this nature, three pieces were broached at a time.

TRADE PUBLICATIONS

BRAKE LINING REPLACEMENT RECOMMENDATION. The Raybestos-Manhattan Division of Raybestos-Manhattan, Inc., Bridgeport, Conn., has prepared a booklet entitled "Brake Lining Replacement Recommendation for Passenger Cars."

CAR WHEELS. The University of Louisville, Speed Scientific School, has issued Engineering Bulletin No. 1, as of June, 1930, entitled "The Annealing of Chilled-Tread Car Wheels in the Foundry of the Louisville Car Wheel and Railway Supply Co."

CONNECTICUT MANUFACTURERS. The State of Connecticut Factory Inspection Department, Hartford, has issued a "List of Connecticut Manufacturers and Their Products" corrected to March 1, 1930.

HEATING ELEMENTS. The Harold E. Trent Co., 439 North 12th St., Philadelphia, Pa., has published Leaflet TA-29 on its electric heating elements and units for all industrial equipment for element temperatures ranging up to 1,900 deg. F.

PATENTS. The U. S. Department of Commerce, Patent Office, has published the "Annual Reports of the Commissioner of Patents to the Secretary of Commerce" for the fiscal year ending June 30, 1930. Copies may be obtained from the United States Government Printing Office, Washington, for 5 cents.

PLATING MACHINES. The Meaker Co., 1615 So. 55th Ave., Chicago, Ill., is distributing Bulletin 313 on "Full Automatic Straight-A-Way and Return Type Plating Machines" and allied equipment for galvanizing, pickling, cleaning and finishing. Material on chromium plating is also given.

TAPS. The Landis Machine Co., Inc., Waynesboro, Pa., now has available bulletin No. G-74 on "Victor" receding chaser collapsible taps. Constructional details and specifications are given for each item. Bulletin G-73 covers "Victor" collapsible and solid adjustable taps.

TAPS, COLLAPSIBLE. The Rickert-Shafer Co., Erie, Pa., has issued Bulletin CT on its collapsible taps, giving photographs and complete specifications for the various models.

WAGES. The U. S. Bureau of Labor Statistics has compiled Bulletin 522 on "Wages and Hours of Labor in Foundries and Machine Shops—1929." Copies, 25 cents from U. S. Government Printing Office, Washington.

WELDED PRODUCTS. The Welded Products Corporation, 16th to 17th and Cleveland Ave., Kansas City, Mo., has issued a catalog in color describing its products, such as steel furniture, welding machines, and similar items.

WELDING OF MONEL METAL AND MALLEABLE NICKEL. Alloy Welding Processes Ltd., Ferry Lane Works, Forest Road, London, E.17, England, has available a booklet "The Welding of Monel Metal and Pure Malleable Nickel," illustrating many examples of such work.

WEST VIRGINIA INDUSTRIES. The State Bureau of Labor, Charleston, W. Va., has issued a "Directory of West Virginia Industries," as of 1928.

NEWS OF THE WEEK

A.M.A. Shop Methods Conference Scheduled in Pittsburgh

SHOP Methods will be the general subject of the conference of the American Management Association, scheduled at the William Penn Hotel in Pittsburgh on Dec. 11 and 12. Following registration on the morning of Dec. 11, C. S. Craigmile will preside at a session under the title, "Introduction to Shop Methods." E. M. Richards will lead the discussion. W. F. Coleman will preside at the afternoon session on, "Organizing for Shop Methods Activities." Three papers to be presented on this subject discuss various phases of the question, including the large company with a single plant, by W. T. Foultz, the large company with several plants, by R. H. Maxson, and the small company with one plant, by S. M. Woodward.

The dinner meeting that evening will take up "The Viewpoint of the Shop Methods Men." The speaker will be P. L. Dildine, with Thomas R. Jones presiding. A. L. Kress will preside at Friday morning's session on process development, with papers being presented by G. E. Schulz, E. O. Larson, George S. Case, and Leonard Baker. The afternoon session will be on the same subject, with papers by C. E. Stevens, C. W. Brostedt, and R. C. Bennett, and a summary by John W. Hallock.

Taylor Society Announces Meeting

The Annual Meeting of the Taylor Society will be held at the Pennsylvania Hotel, New York City, Dec. 3-5, beginning on Wednesday morning, Dec. 3, with a talk on, "Factors in the Elimination of Distribution Waste." A joint meeting with the National Association of Credit Men will be held that afternoon on, "A Balance Sheet of Management to Supplement Financial Statements As a Basis for Credit Ruling." An evening session will be on the general subject, "Some Problems of Management During the Past Decade." Thursday morning's program will be on, "The Maintenance of Standards," and that of the afternoon will be simultaneous group discussions on comparison of time-measuring mechanisms, problems of office management, and the place of merchandising in industrial organization. The annual dinner of the Taylor Society will be held that evening with Maj. Gen. William Crozier and Mrs. Crozier as guests of honor. Friday morning's session will be on, "Technological Unemployment," the afternoon discussion on, "An Industrial Code," and that of the evening on, "The New Challenge to Scientific Management."

Purdue Announces Welding Conference

The Engineering Extension Department of Purdue University recently announced its Sixth Annual Conference on Welding, to be held at Lafayette, Ind., on Dec. 10-11. This two-day educational conference will deal with the latest developments in the application of welding as applied to manufacturing operations and maintenance problems. Programs and detailed information may be obtained from the Department.

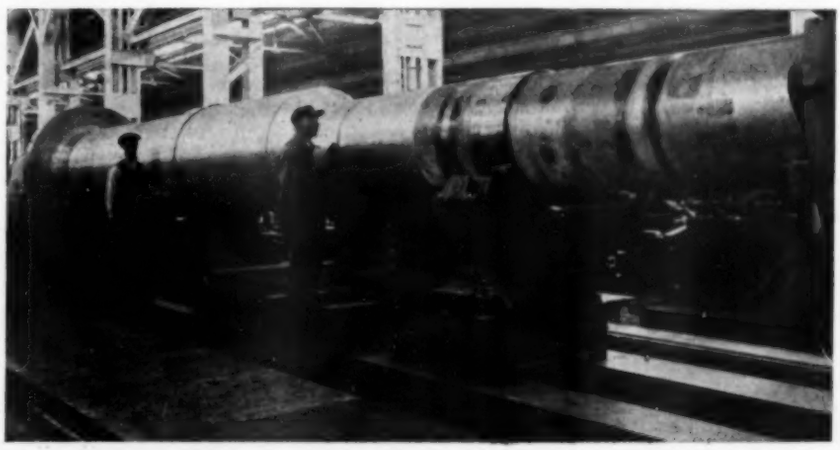
Corporation Profits Decline 25 Per Cent

Aggregate profits of 640 corporations for the first nine months of 1930 were 24.42 per cent under the profit of the same companies in the corresponding period of 1929, according to compilations made from published reports by Ernst & Ernst, accountants. For 271 industrials in twenty-five lines and miscellaneous, the compilations show that total net profits for the first nine months were 36.28 per cent less than in the same period of 1929. Net operating income for 171 railroads was down 31.51 per cent for the nine months. The largest industrial groups, measured by profit volume, show: Automobiles, decline of 51.98 per cent, Iron & Steel, decline of 45.96 per cent, and Oils, decline of 33.66 per cent. Net profits on machinery and tools for the first nine months were $68,920,000, as compared with $89,438,000 in the same period of 1929, which gives a decrease of 22.94 per cent, considerably less than the decrease of 36.28 per cent for the industrial group as a whole; compared with the profits for a similar period of 1928, however, the profits for the first nine months of 1930 are 1.36 per cent higher.

Franklin Lecture At Franklin Institute

The Franklin Institute, Philadelphia, Pa., will have a series of free lectures on Dec. 29, 30, and 31, on the general subject of "The Scientific Work of Benjamin Franklin." Dr. E. E. Free of New York City will be the lecturer. Detailed information is available from the Secretary, The Franklin Institute, South 7th St., Philadelphia, Pa.

THE Soviet Trade Delegation, headed by Saul B. Bron, has agreed to place $3,000,000 worth of machine tool orders in Great Britain, through its British agent, Arcos, Ltd. The Associated British Tool Makers, represented by Greville Maginness, chairman, will extend full credit to the Russians, and will also supervise the construction of tool-making plants in Russia.



Weighing 136,000 lb. and more than 36 ft. long, this one-piece generator shaft forging will transmit 84,000 hp. and sustain a vertical load of 2,000,000 lb. after installation in the U.S.S.R. It is here being prepared for final grinding at the G.E. Schenectady plant

French Industrial Situation Shows Depressing Factors

By Our Paris Correspondent

ADMITTEDLY, all classes in France see world industrial unrest as a factor in French production and distribution, which is now steadily growing more and more feeble. Not only the European situation, but that of South America also, affects French conditions. What happens in the United States has almost no effect.

M. Briand's idea of the European economic union has by no means general approbation, even in France, though if it does result in a preferential tariff between nations, virtually free trade will result in certain groups of commodities between certain nations. There is foreseen, not only by the French but by others, a slowdown here and there in the interests of commercialized brotherly love. It has, moreover, brought up the question of the status of the "most favored nation" cause which so many countries not a part of group have signed. As the Dutch delegate said at the League of Nations assembly in October, "The question is a spiny one."

Lowering prices of raw materials do not appear to be helping quantity production to the extent that might be expected. The capacity of the buying public to absorb and the final consumer cost of most metal products, are far more potent reasons for shrinking sales.

The automobile industry, always a barometer, is professedly not up to expectations. Some plants are running at full speed, but in the majority of cases the opposite appears to be true. Some 30 tons of manufactured steel automobile parts were junked recently at a bargain sale for the price of the metal. This shows at least the uncertain attitude in the industry—perhaps an entire about face in manufacturing processes. To that extent it may extend new outlets for tools and machinery, but until more is known it is futile to speculate.

France more than ever professes to be interested in imports of machine tools from Germany, but imports during the past three months have fluctuated, tending towards lower levels than for some time past. The truth is that new plant installation, as distinct from the adding of new or special machinery, is at a low ebb. The situation is what the French call "unequal," meaning, in this case, variable. Many self-contained plants have slowed down in certain departments for the sake of keeping going on other more profitable lines. Orders are satisfactory for a reduced output, seldom so for a progressively high output.

Electrical machinery is in a better position than most other mechanical lines, but rolling stock orders by the seven principal railways are rarer than they were. Many orders likely to materialize in the five-year program have already been counted on.

Industrial credits for equipment or the financing of export sales have undoubtedly been lacking. At least one American financial corporation is bidding for business in France in that it opened offices, during the Automobile Salon, in the Hotel Claridge in Paris. If business develops, this may be looked upon as a helping hand to the automobile and similar industries which are said to furnish a direct livelihood to half a million workers. The automobile industry alone is claimed to be working ten per cent more labor than a year ago. The future is not bright, however, for the used car market accounts for 22 per cent of the total automobile sales within the country. Automobile exports are apparently not increasing, and two foreign cars are imported for every five French cars exported. The industry claims a gross turn-over of 1,500,000,000 francs per annum, ranking seventh among the country's industries.

French industry in many cases is undoubtedly producing at low costs, considering that raw material factors are French wage scale is as low as it is. If much the same for all the world and the the German Chancellor Brunig's scheme for lowering wages in Germany's metal trades six per cent produces the results anticipated, Germany's entrance in the "big tent" will be by the main portal rather than by the hole in the wall through which it dribbling its output today.

At that, in 1929, France was Germany's best customer for machinery and tools—78,700,000 marks in value; electrical goods figured at 22,600,000 marks; tools and other iron and steel manufactures, 27,700,000 marks. This is a far better showing than that of Great Britain, which sold a larger valuation of machinery to Holland than to France.

Many French industrial enterprises, in spite of the influence of what the French please to call "the world crisis," continue to pay normal dividends—usually out of reserves, a common enough practice here, differing greatly from what occurs in America. All forces from the government downward through the great national industries seek to bolster dividend distribution artificially in this manner. Its failure, as the result of a prolonged crisis, will affect industrial capitalization seriously, above all getting in capital for expansion.

The Frankfort *Gazette* (German) refers to the situation in France as privileged because of the above, and also proclaims that French manufacturers are less interested in expanding their enterprises than in giving satisfaction to their shareholders. Restrained bank credits also discourage rapid expansion at this time, as they have in more favorable times.

The price index of minerals and metals has fallen 24 points, from 530 since May, though food stuffs in general have risen. Imported products stand at 428, having fallen from 485, while national products have risen from 590 to 595. This is considered as discrediting French organizing ability, though scarcely admitted by the world of industry and finance. It does, however, say more to the outsider, as well as to the French working man who, in Paris, has found his living costs increase from 572 to 592 in the last six months. In the Paris district, there has been a rise of 61 points since the first of January, 1929.

Foreign trade for the first three-quarters of the year, as compared with 1929, was unfavorable for France to the extent of 7 billion francs. Imports and exports decreased nearly 4½ billion francs each. There was, however, an increase in the tonnage of imports but a falling away in the tonnage of exports. Raw material for industry was most affected in the former classification and exports of manufactured goods in the latter.

Unemployment Conference Planned in New York

A national conference to consider permanent methods for combating unemployment through governmental and private agencies has been called by the American Association for Labor Legislation to meet at Cleveland, Ohio, Dec. 29-31, according to a recent announcement at the Association's headquarters in New York City. The meeting will bring together leading authorities on unemployment problems, including representatives from the official state and city unemployment committees. It will convene in conjunction with the twenty-fourth annual meeting of the American Association for Labor Legislation, which held similar unemployment conferences in 1914 and 1921.

Urge New England Lead Trade Revival

Speakers at the annual "town meeting" of the New England Council were uniform in their insistence that New England lead the van in the march toward trade revival. "Prepare for better business ahead," said Redfield Proctor of Vermont, president of the Council, "We do not have to wait for the rest of the United States!" Similar statements were made by governors of the six New England states who were in attendance, and by Roy H. Young, governor of the Federal Reserve Board in Boston. A commendatory telegram from President Hoover was also read at the first session. A program of the meeting was given in *American Machinist* on page 726c.

BUSINESS ITEMS

The Thomas & Skinner Steel Products Co., Indianapolis, Ind., has taken over the warehousing and jobbing of Follansbee pickled steel sheets made by Follansbee Bros. Co., Pittsburgh, which has discontinued its Indianapolis warehouse. E. C. Folkening of Follansbee Bros., will continue as district sales manager with office in Indianapolis. The Thomas & Skinner Co. has also been appointed distributors for stainless steel and stainless iron made by the Simonds Saw & Steel Co. of Lockport, New York.

The Union Wire Die Corporation, 333 West 52nd St., New York, N. Y., recently concluded another contract with the Krupp Co., Essen, Germany, covering the manufacture of Widia tools. The company has already had a contract for the manufacture of dies of Widia metal for drawing purposes. Orders for machinery for the manufacture of these tools have already been placed and negotiations for manufacturing space are under way.

The Canadian Rumely Co. Ltd., Abell St., Toronto, was recently purchased by Alfred Davis of Toronto. Through negotiations carried on for some months with the Advance Rumely Co. of Chicago, Mr. Davis has acquired the entire plant and business, with its paid-up capital of $700,000 and its property free of emcumbrances. The plant is one of the largest in Toronto. It covers approximately eight acres of land, contains 250,000 sq.ft. of space and has three railway sidings. Buildings include grey iron foundry, steel fabricating department, machine shop, and light forging department.

Lynn Canadian Products, Ltd., has been formed to manufacture the line of Lynn oil burners and Lynn heating appliances at Brockville, Ont. Canadian capital is represented by H. H. Vaughan of Montreal, president, and Dr. Milton E. Hersey of Montreal, treasurer. L. E. Johnson, controlling the Lynn (Mass.) Products Co., is vice-president, with G. N. Ogden, secretary. The company has taken over a large modern factory at Brockville, and expects to start operations shortly.

The Everite Manufacturing Co., Inc., has established temporary headquarters at 3144 College Ave., Berkeley, Calif. This firm has developed a patented traffic signal to be used entirely by commercial vehicles. Officers are Joseph D. Stafford, president; James Phillips, vice-president; M. J. Engelhardt, secretary, and F. L. Thompson, treasurer.

The Wisconsin Aluminum Foundry Co., South Sixteenth & Franklin Sts., Manitowoc, Wis., an established aluminum casting company, has been incorporated in Wisconsin with $250,000 capital. There is no change in ownership and management. Abe Schwartz, Edwin Pleuss, and Wm. Ecke are principal officers.

The Iowa Manufacturing Co., 924 Sixteenth St., Northeast, Cedar Rapids, Iowa, has started construction of a $20,000 road machinery assembly plant, according to Howard Hall, president. The building will be 205 ft. long, 60 ft. wide and 40 ft. high, with walls of glass set in steel sash. It will connect the old factory building and the present office unit.

Dick Orr, 12-year-old son of P. K. Orr, Supervisor of Welding for Westinghouse, who recently fused electrodes into smooth, uniform beads after only an hour's practice with a Flex-Arc welder, demonstrating the ease of handling the arc

Articles of incorporation were filed recently for the Northwest Machinery Co. of Boise, Idaho, formed by contracting firms of the Northwest for the purchase of machinery and supplies. The new company will be located at 710 Front St. Officers are W. C. Dewey, Nampa; C. C. Cowley, Harold Quinn, and Paul Brooks of Boise, A. G. Holland, and W. J. Smith.

The new structure of the Waterloo-Sunshine Co., at Waterloo, Ont., has been completely closed in. Pouring of concrete floors has commenced and the plant will be ready in all details for installation of equipment in about one month. The building is a one-story structure, with a floor space of 130,000 sq.ft. The plant is expected to go on a producing basis, turning out Sunshine-Waterloo thresher combines, about the beginning of 1931.

The Noonan-Malstrom Co., Chicago, has purchased the Monighan Foundry Co., including the foundry plant at 2135 Cairo Ave., and a machine shop at 1845 Cairo Ave. The buying company now occupies the latter property, improved with a 2½-story building, and will continue to maintain sales offices there. It will also continue to operate the machine shop enterprise as the Monighan Division of The Noonan-Malstrom Co.

The Shawinigan Stainless Steel & Alloys, Ltd., controlled by Shawinigan Chemicals, Ltd., the first foundry in Canada to confine itself exclusively to the manufacture of alloy steel castings, has been licensed by the Krupp Nirosta Co. to manufacture Krupp alloys under Krupp supervision.

The Premier Gear & Machine Works, 17th & Thurman Sts., Portland, Oregon, has a 1½-story concrete building practically complete. The first unit of the plant contains 10,000 sq.ft. of floor space. In addition to gear-cutting, the firm manufactures special types of machinery.

The Armstrong Manufacturing Co., 21st St. and Roosevelt St., Portland, Oregon, has recently moved into its new L-shaped warehouse, shop, and office building. The largest wing is one story, 149x66 ft., and housing the warehouse. The remaining wing is 130x45 ft., one story in height, of concrete construction, and contains offices, drafting room, and shop. The entire building includes 18,386 sq.ft.

Demco, Inc., 105-115 S. Calvert St., Baltimore, Md., doing general and experimental machine shop work, has purchased a plant at Bush & Nanticoke Sts., to be occupied as soon as possible. The building is 2-story of brick construction and contains about 35,000 sq.ft. of floor space. James F. Myrick is president.

Rainbowcraft, Ltd., has been organized in Canada with a capital of $500,000 for the purpose of building motor boats. The factory will be at Gravenhurst, Ont., and offices and showrooms will be in Toronto. Thomas Greavette, who for many years has been identified with Ditchburn Boats, Ltd., of Gravenhurst, is general manager.

The Horton Steel Works, Ltd., Bridgeburg, Ont., has acquired from the Canadian Barking Drum Co., Ltd., the rights to sell and service, as well as to manufacture, U-bar barking drums and accessory equipment. Formerly, the Horton Steel Works, Ltd., handled only the fabrication of equipment.

The American Metal Products Co., 34th & Burnham Sts., Milwaukee, Wis., changed its name as of Nov. 1 to Ampco Metal, Inc., and increased its capital stock to $500,000. C. J. Zaiser is president.

The Republic Steel Corporation has just placed in operation at its Youngstown plant the largest ladle crane in the world. The crane, with its 275-ton capacity, is a part of the $1,000,000 improvement program at the plant. Two additional cranes of the same size will soon be installed. In a test, the new crane lifted 343 tons of steel.

The DeWitt Tool Co., New York City, has opened a branch store at 1719 Williams St., Newark, N. J.

The Pipe & Tube Products Corporation, with offices in the Woolworth Bldg., New York City, has been formed by J. L. Sussman and R. K. Senter. Mr. Sussman was formerly president of Steel & Tubes, Inc., and also the founder and president of the Michigan Tube Co., until it was merged with the Elyria (Ohio) Iron & Steel Co. Mr. Senter has been a New York dealer in non-ferrous products.

The American Radiator Co., New York, recently ordered 100,000 tons of pig iron to be shipped between now and the end of the first three months of next year. The order is one of the largest tonnages of pig iron in orders placed by one corporation in a long while in the Birmingham, Ala., district. The deal is estimated at around $1,000,000.

The Morse Chain Co., Ithaca, N. Y., a division of the Borg-Warner Corporation, will hold the annual holiday party of the Associated Morse Industries on Dec. 9. Approximately 150 factory foremen, office men, and superintendents of the Morse Chain Co., Barr Morse Corporation, Poole Manufacturing Co., Morse Products, Inc., and the Ithaca Railway, Inc., will be in attendance.

The Berkel Products Co., Ltd., started operations a year ago in Toronto. The company has found it necessary to increase its manufacturing space three times since that time. The present expansion is approximately 1,100 sq.ft.

The Knapp-Monarch Co., St. Louis, which has been operating a factory in Webster City, Iowa, has purchased the abandoned plant of the National Carbon Co., Belleville, Ill., and the first of the year will begin operations there. Factory, offices, die, and tool experimental shops will be transferred and concentrated in the 22 fireproof buildings on the 22-acre site.

Dominion Foundries & Steel, Ltd., Hamilton, Ont., is spending approximately $300,000 on improvements to its plant. This expenditure is largely in connection with additional heating capacity for the large plate mill; improving the jobbing plate mill for rolling light plates from ¼ in. down to 12 ga. in thickness, and making changes in the open-hearth plant.

The H. F. Eaton Co., 50 Church St., New York City, was recently appointed New York representative (including New Jersey and a part of Massachusetts) of the Davis Boring Tool Co., 6200 Maple Ave., St. Louis. The Evans Tool Co., 335 South Central Ave., Los Angeles, was appointed Los Angeles and Southern California representative. Wessendorf, Nelms & Co., 317 Preston Ave., Houston, Texas, has been appointed representative in Texas and Louisiana.

W. Blackburn and J. Ion have opened the Westminster Boiler & Tank Co., in New Westminster, B.C., with a plant located at 1103 Columbia St. Mr. Blackburn was previously with the Cranby Co., at Anyox, and Mr. Ion has for the past 20 years been with Nelson's Foundry, New Westminster.

The Curtis-Wright Export Corporation, New York, has completed erection of its first overseas manufacturing plant at Los Cerrilos airport, Santiago de Chile, and has begun production. The plant consists of three buildings comprising the main factory, hangar, and dope shop. The two main buildings are 100x200 ft. and 119x120 ft.

American Bauer Wach Corporation, 11 Broadway, New York, N. Y., organized some time ago, has recently been reorganized and the following officers have been elected: President, F. W. Kennedy; vice-president, James S. Milne; treasurer, L. S. Rice; secretary, H. L. Watson.

The Clinton Machinery Co., 126 S. Clinton St., Chicago, Ill., has taken over two additional floors at its present location to provide space for $50,000 worth of used equipment recently purchased.

The Sierra Equipment Corporation, Los Angeles, San Francisco, and Seattle, has been appointed exclusive sale sagent and distributor in the Western territory by the Falls Electric Furnace Co., Buffalo, N. Y.

The Warren Pipe Co. of Massachusetts, Inc., 75 Federal St., Boston, is opening a new foundry in Everett, Mass. The company is a subsidiary of the Warren Pipe Corporation of New Jersey, and Charles O. Butler is superintendent.

Alford H. Schutte of Cologne, Germany, celebrated on Nov. 1 the fiftieth anniversary of the company's entrance into the metal-working industry.

The Ex-Cell-O Aircraft & Tool Corporation, 1200 Oakman Blvd., Detroit, has added a broach department, equipped for making all types of broaches and gages for checking broached parts.

Seth Thomas Clock Co. stockholders voted Nov. 12 to merge with the Western Clock Co., LaSalle, Ill. The consolidation will be made through an exchange of stocks. No date has been set for the merger.

The Michigan Steel Corporation has completed its program of plant expansion and rearrangement at its mill at Ecorse, Mich.

The State Machinery Sales Co. has been formed in Detroit by H. P. McCarthy and C. H. Cox to handle machine tool liquidations and sales. Offices are at 546 Woodbridge St., East.

The Electro-Motive Co., Cleveland, Ohio, has been purchased by a subsidiary of the General Motors Corporation, but will be operated as an independent unit under direction of the present management.

The Thew Shovel Co. and the Universal Crane Co. have moved their Atlanta (Ga.) sales offices to 1513-14 William Oliver Bldg.

PERSONALS

Carroll M. Aument has been elected president of the Flying Dutchman Aircraft Corporation, New York City. His previous connection was with the Fokker Aircraft Corporation of America, Hasbrouck Heights, New Jersey, where he was factory manager.

Kelvin C. Backhouse, having relinquished his post as assistant chief engineer for the Godward Gas Generator Co. Inc., New York City, is now employed as superintendent of the H. A. Smith Machine Co., Hopewell, N. J.

Walter E. Battles, who resigned recently as production manager of the Ward La France Truck Corporation, Elmira, N. Y., is now employed as mechanical engineer for the Pennsylvania Power & Light Co., Allentown.

Austen Bolam has recently become associated with the research division of the Sherman Corporation, with offices at 292 Madison Ave., New York City.

Henry W. Buzzell, Montreal, and formerly with Harrington & Cortelyou, consulting engineers, Kansas City, has become associated with the Dominion Bridge Co., Ltd., Lachine, Que.

W. D. Flannery (right) new president of the International Acetylene Ass'n, receives the congratulations of C. A. McCune, retiring president. Attendance this year increased 30 per cent

W. D. Cameron has been appointed manager of the Detroit office of the General Electric Co., to succeed the late J. H. Livsey, according to a recent announcement. Mr. Cameron has been assistant manager of the Detroit office since 1927.

P. M. Carpenter, General Manager of the Crankshaft Division, General Motors Corporation, Saginaw, Mich., has been elected vice-president and general manager of the Jackson (Mich.) Motor Shaft Co., a recently acquired subsidiary of the Muskegon Motor Specialties Co. H. O. Hess, Factory Manager at the Saginaw plant, has also become affiliated with the Jackson Motor Shaft Co.

Harold Clark of White, Weld & Co., Detroit, has been elected a director of the L. A. Young Spring & Wire Corporation, Detroit, to succeed J. Mitchell Hoyt of Prince & Whiteley.

Edwin Corning resigned the presidency of the Ludlum Steel Co., New York, N. Y., on Nov. 13. Mr. Corning was immediately elected to the newly created office of chairman of the board. H. G. Batchellor, formerly vice-president, was elected president.

Ralph M. Dravo, Vice-President of the Dravo Contracting Co., Pittsburgh, has resigned as chief of the Pittsburgh Ordnance District, a position which he had occupied since 1922. Frank L. Bell, President of the Edgewater Steel Co., Oakmont, Pa., succeeded him.

E. A. Emerson, Vice-President and Managing Director of the Armco International Corporation, Middletown, Ohio, and W. L. Allen, President, Sheffield Steel Corporation, Kansas City, Mo., have sailed for France and England on foreign business of the American Rolling Mill Co., parent corporation.

E. L. Ferguson will become plant manager for the Empire Steel Corporation, Mansfield, Ohio, effective Dec. 1. He has been superintendent of the Falcon Works, Niles, Ohio, for the past two years, but will now handle the Falcon, Waddell, and Thomas plants.

P. N. Guthrie, Jr., was recently elected president of the Reading Iron Co., to succeed Leon E. Thomas. Mr. Guthrie was formerly vice-president in charge of sales.

John Howe Hall has been appointed technical assistant to the president of the Taylor-Wharton Iron & Steel Co., High Bridge, N. J. He will have full supervision of all research activities, and be general advisor on manufacturing methods and sales engineering.

Charles P. Hayden, and Curtiss A. Sanford, President and Treasurer of Hayden, Stone & Co., New York, were on Nov. 6 elected directors of the Otis Elevator Co., New York City, to succeed William D. Baldwin, decreased, and Eugene V. R. Thayer, resigned.

C. L. Hull has been appointed sales manager of the Detroit Division, Square D Co. He was formerly assistant sales manager under A. A. Schueler, who has been appointed sales manager of the Diamond Electrical Manufacturing Co., Ltd., Los Angeles, Calif., affiliated with the Square D Co.

H. B. Kilroe has been appointed the representative of the Allied Die Casting Corporation, Long Island City, N. Y., for the Southern Ohio territory, covering Dayton, Columbus, and Indianapolis. Mr. Kilroe's headquarters are at 507 Dayton Industries Bldg., Dayton, Ohio.

A. J. McFarland has resigned as general manager of the Follansbee, W. Va., plant of the Follansbee Bros. Co., to become first vice-president of the Wheeling (Va.) Steel Corporation.

W. Bruce Pirnie has resigned as president of the Cheney Bigelow Wire Works, Springfield, Mass., but remains on the board of directors. H. Y. McMullen has been made treasurer to succeed Alexander Warden.

John C. Phelps has been appointed sales manager of the Universal Gear Corporation, 327 South La Salle St., Chicago, Ill. Fred M. Potgieter continues in charge as vice-president and general manager.

W. H. Scanlon has been appointed manager of the new bar and structural department of the Weirton (W. Va.) Steel Co. He was formerly associated with W. J. Rainey Inc., Pittsburgh.

A. S. Seaman, formerly a vice-president of the Allegheny Steel & Brass Corporation, Chicago, has opened his own offices as a sales representative at 80 East Jackson Blvd., Chicago.

Albert M. Steadfast, for many years sales representative of Steadfast & Roulston, Inc., Boston, was recently made vice-president and director to succeed the late J. W. R. Roulston.

A. H. Tallman, for many years president and manager of Tallman Brass & Metal, Ltd., Hamilton, Ont., is forming a company to manufacture bronze and aluminum castings and babbitt metals. The company has leased the P. B Yates foundry in Hamilton.

OBITUARIES

Tracy W. Guthrie, 62, once president of the Republic Iron & Steel Corporation, Pittsburgh, Pa., died at his home in Pittsburgh on Nov. 15.

Henry Harnischfeger, 75, president and one of the founders of the Harnischfeger Corporation, Milwaukee, Wis., died suddenly on Nov. 15.

E. F. Kitselman, 60, Secretary of Kitselman Bros., Muncie, Ind., and secretary and general manager of the Indiana Steel & Wire Co., as well as vice-president of the Muncie Oil & Engine Co., died on Nov. 10, in Rochester.

Fred A. Lundahl, 47, president of the Moline (Ill.) Pressed Steel Co. since it was formed 20 years ago, died on Nov. 14.

Hector Morrison, 48, an executive of the Campbell & Grill Sheet Metal Works, Seymour St., Vancouver, B. C., died on Nov. 9 at his home in that city.

Dr. Richard Moldenke, 66, leading metallurgical expert and consulting metallurgist for many companies, including the Worthington Pump & Machinery Corp., the Bethlehem Steel Co., the United States Cast Iron Pipe & Foundry Co., American Cast Iron Pipe Co., and the Babcock & Wilcox Co., died at Plainfield, N. J., on Nov. 17, after a major operation. Dr. Moldenke specialized on the metallurgy of cast iron and was an expert on malleable castings.

Charles Prentice Turner, 68, at one time chief engineer of the Steelton, Pa., plant of the Bethlehem Steel Co., and later in the Bethlehem development and research department, died recently in that city.

W. Hull Western, President of the Manufacturers' Co., New York City, died on Nov. 11 at his home in Plainfield, N. J.

FORTHCOMING MEETINGS

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Calvin W. Rice, executive secretary, Engineering Societies Bldg., 29 West 39th St., New York, N. Y. The following meetings are scheduled:

Fifty-first annual meeting, Engineering Societies Bldg., Dec. 1-5.

Semi-Annual meeting, Birmingham, Ala., Apr. 20-23, 1931.

National Materials Handling Meeting and Management congress, Cleveland, Ohio, Apr., 1931.

National Aeronautic Meeting, Baltimore, Md., May, 1931.

TAYLOR SOCIETY—Annual meeting, Dec. 3-5, Pennsylvania Hotel, New York City. P. E. Henderson, Associate Secretary, 29 West 39th St., N. Y. C.

NINTH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING—In Grand Central Palace, New York City, Dec. 1-6. Charles F. Roth, manager, Grand Central Palace.

AMERICAN MANAGEMENT ASS'N—Shop Methods Conference at William Penn Hotel, Pittsburgh, Pa., from Dec. 11-12. Headquarters, 20 Vesey St., New York, N. Y.

WESTERN METAL CONGRESS AND EXPOSITION—Second National, Civic Auditorium, San Francisco, Calif., Feb. 16-20, 1931. Under auspices of A.S.S.T. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

THREE-M-CONGRESS — Management, Maintenance, and Materials Handling Congress and Second National Industrial Equipment Exposition, Cleveland, Ohio, April 13-18, 1931. In the Arena and Exhibit Hall, Cleveland Public Auditorium. Information from the A.S.M.E., 29 West 39th St., New York City.

THE INDUSTRIAL REVIEW

Weekly progress of the machinery and machine tool business

PIOUS RESIGNATION has replaced expectations of a big Thanksgiving in machinery and machine tool markets. The general opinion seems to be that nothing of importance one way or another will occur before the first of the year, and that subsequent upturn will accompany the bluebirds. Inquiries of the past week presage a little merrier Christmas, however, for they have the assurance of orders, rather than the mere getting of prices to add to the files, a characteristic of inquiries for the past several months. One cheering prospect of the situation is the fact that manufacturers are utilizing the slowness to perfect improved models which will be available later.

NEW YORK'S market is as it was, with the exception of an improvement in inquiries. The recent Norfolk & Western inquiry is outside the territory, so created little excitement. New England expects present conditions to continue until the bugaboo of depression has been lastingly squelched. Los Angeles reports a few car wheel orders among sales to railroad shops, while possible oil field purchasers are transferring equipment instead of buying new. Chicago considers the Illinois Steel inquiry just an inquiry and nothing more, after several months of expectancy, though sales are better so far than they were in September and equal to those of last month. Canada reports betterment in iron and steel conditions, and in the radio and electrical industries.

DETROIT is feeling better after a few sales to automotive plants, and November totals are expected to surpass those for October. Pacific Northwest sales are slow, largely because of the slowness of the lumber industry. Cincinnati suggests, facetiously, that salesmen carry a pulmotor to bring prospects back to sales consciousness.

NEW ENGLAND

Officials are apparently resigned to conditions as they actually are. The scattered distribution of machinery, as reflected in the week's demand, was no better than in recent weeks, nor any worse, nor is the volume a true picture of potential demand. Buyers are not interested in a program of forward buying at this time. General opinion frames the belief that depression psychology has tightened the purse strings where money might well be expended to advantage. It will take more than a mere flurry of optimism to kill this bugaboo of exaggerated proportions.

LOS ANGELES

The month of November has exhibited no marked changes from recent months. A certain number of tools are of course being sold, turret lathes, millers, and engine lathes. Among other tools, a few car-wheel borers have recently been sold to local railroad shops, although these shops, like various other machine plants, are proceeding on an economical purchasing basis. The oil tool and equipment shops are still finding it unnecessary to add appreciably to their manufacturing facilities, because of the conservative purchasing of oil field supplies even in districts where drilling activities are conspicuous. Much of the necessary apparatus for the carrying on of this line of work is transferred as required from other and older fields.

CHICAGO

During the last few months the Illinois Steel Co. has made inquiry occasionally for prices on a number of tools of varied types, and bidders have been looking forward expectantly to closing on some of these units. It is now announced on good authority that the Company will do no buying until after the first of next year, but just how soon after has not been disclosed. Most inquiries from other industrialist sources are reported to be still in abeyance. The machine-tool situation in general shows but little change from week to week, although an occasional encouraging report varies the monotony of a depressed market. One concern which acts as selling agent for several lines of standard tools reports its sales for October as about 30 per cent ahead of those for September, with November business thus far maintaining the same percentage of increase. The demand for lathes is reported to have shown some improvement recently, as also has that for machinist's tools. With these exceptions, market conditions remain practically unchanged.

CANADA

There has been very little change in conditions during the last two weeks. Slight improvement has occurred in industry generally, largely, however, of a seasonal character and not sufficiently marked to raise the general level very much above that of late summer. Perhaps the feature is betterment in iron and steel conditions. The mills at Sault Ste. Marie are already working on new orders for the Canadian Pacific Railway, while those of the Dominion Steel and Coal Corporation at Sydney are expected to go on double shift the first of the year. No betterment is evident in the automobile industry, and agricultural implement production is still at a low point. Radio manufacturers report business better than ever and the market for electrical goods continues to improve. While railroad buying of rolling stock has been almost negligible during the last few months, preliminary reports regarding operations of the Canadian Car & Foundry Co., indicate that the fiscal year ended Sept. 30 was the most successful in the company's history, even exceeding the record showing made in the previous year. It is understood that there are good possibilities of railway business.

DETROIT

A note of encouragement has become apparent here within the last ten days and contrasts with the atmosphere of depression that has prevailed since September. A few sales of machinery and machine tools have given an upward tilt to the market and the inquiries have increased preceptibly also. Some of the sales are for specialized equipment to replace machines worn out in service, and this particular deal does not constitute an evidence of better conditions. Some of the other sales, however, are encouraging.

Motor car manufacturers are displaying a more optimistic attitude than they have for many months and at the moment are deeply interested in turning out new models. Thus far the increase in employment has had no bearing on the machinery and machine tool trade, and unless the new cars are put in heavy production it is certain there will be no great demand for equipment. Totals for November will be much better than for October, but it is believed the seasonal slacking up in December will hold down the figures for that month.

NEW YORK

Inquiries of a somewhat firmer sort began coming into machinery and machine tool dealers last week, but are as yet unfollowed by orders. They are usualy of the single-tool variety for maintenance or replacement in a wide variety of industries. The Norfolk & Western inquiry, though large in point of size, was described as "nothing to get steamed up about," since the inquiry is out of the territory of most New York dealers and besides was broadcast over the country in a suspected endeavor to get shaded prices. Meanwhile, Ford is speaking of $60,000,000 invested in nine plants, steel pipe mills see increasing business over the next five years, Bell Telephone will spend $500,000,000, plus $100,000,000 for expansion of Western Electric, and the railroads are planning to repair idle equipment to avoid lay-offs.

PACIFIC NORTHWEST

Sales of machine tools and shop equipment are slow. The business level has been unsatisfactory since June, and with the approach of inventory time no improvement is anticipated during the balance of the year. Depression in the lumber industry, which is operating at only 45 per cent of capacity, is affecting the shop equipment market, both directly and indirectly. Many machine shops are either closed or operating part time, so that demand for equipment is at a minimum. The ship repair and automotive branches are making only necessary purchases, and no large deals have been closed for some time, nor are any important orders up for figures. Dealers in grading and road equipment are in better position as highway work is to continue as long as the weather will permit, public projects having been advanced as much as possible to relieve unemployment. Precision valve makers report an increase this month of 20 to 25 per cent.

CINCINNATI

With the optimistic patience of Micawber, machine-tool manufacturers of the Cincinnati district are waiting for something to turn up. They are not, however, like the expectant fictional character, merely waiting in a passive way: they are doing all they can to overcome the unresponsiveness of users, most of whom seem to have been made somnolent by some strange anesthetic that pervades the business atmosphere. In referring to this condition, a manufacturer stated facetiously that every salesman should carry a pulmotor with which to bring his prospects back to a state of business-consciousness.

Orders received in the past week were well scattered and well diversified. The greater part of the business booked came from miscellaneous users and the requirements were largely confined to single items. Among the week's inquiries was a fair-sized list from the Norfolk & Western Railroad, calling for a variety of tools. A fair volume of general inquiries came from miscellaneous users.

BUSINESS • BAROMETER

Conflicting indications obscure the future trend of business

THEODORE H. PRICE
Editor Commerce and Finance, New York

SUSPENSION of a large number of banks, chiefly in the financial region tributary to Nashville, Tennessee; a foreign trade statement for the month of October which shows a very substantial decrease in both exports and imports; the possibility that delays in the short session of Congress will compel President Hoover to call a special session to appropriate the running expenses of the Government; the continued talk of unemployment and the efforts that are being made to create jobs for the jobless; the operations of the United States government in the wheat market as a result of which Chicago is 10 to 15 cents over Winnipeg and the European markets; a political eruption in Spain where the present monarchy appears to be seriously threatened; the continued attraction of gold to France, to the increasing concern of Great Britain, from which most of it is drawn; and the publication of some letters from Russia which describe the internal condition of that country as almost intolerable—these are some of the salient features of the composite picture that includes last week's happenings.

Each of them reflects some maladjustment in the politico-economic machinery upon the operation of which the world is more or less dependent. Hence, it is gratifying to point out that this maladjustment has not had much effect upon prices or the volume of business that is passing in the wholesale markets.

The published comparisons with last year deal only with the money value of the goods sold. Totals thus compiled show an average of from 6 to 10 per cent decrease in sales. This practice is followed because it would be almost impossible to make reports that would deal with the quantity (pounds or yards) of goods sold, and their money value comes nearer to showing the trend of trade than any other statistics that are available. This is important, and should be borne in mind by all those who are trying to draw conclusions from current figures.

At many of the commodity exchanges the prices registered are somewhat lower. The decline probably reflects the uncertainty that has been created by the action of the Government in entering the wheat market. Much confusion has been the result, and the policy followed is provoking great criticism. The government, through the Stabilization Corporation, now owns more than 100,000,000 bushels of wheat and apparently intends to buy as much more as necessary to keep the Chicago price above foreign markets. The difficulty with this policy is that when a patient becomes addicted to a medicine the dose must be constantly increased to give the expected effect.

THE BUSINESS WEEK

November 26, 1930

THE VISIBILITY is very low and does not increase as week by week we come nearer the veil that seems to shut off a clear view of 1931 prospects in business, commodity, or security markets. . . . A haze of uncertainty hangs over the efforts being made to stabilize commodity prices and to secure effective international financial co-operation toward restoring confidence in long-term investment. . . . Steady vision is disturbed by the continued decline in indicators of business activity as we drift through the fag end of a poor year. . . . Our index dropped off further, from 79.5% to 78.2% of normal, though the declining tendency is not as uniform as it has been in recent weeks. . . . Steel and building are not giving way to the usual year end slump as rapidly as might be expected. . . . Concerted resistance to further deflation of copper, iron and steel, wheat, and sugar prices is a justifiable experiment, but the outcome is doubtful. . . . Better buying of bonds by banks and apparent accumulation of cheap stocks by large interests are further hopeful signs of stabilization in financial markets, though Wall Street is not yet ready to discount 1931 business improvement. . . . Beyond the turn of the year all that can be seen with reasonable certainty is improvement in steel under increased railroad and automotive demand, and in automobile production as deferred buying power comes into the market with the new year sales appeal. . . . The holiday trade will test general purchasing power, and in face of curtailed production during the rest of the year will probably provide the basis for general quickening of industrial activity early next year.

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The cotton market has been remarkably steady, although the demand for cotton goods shows the usual seasonal slowing down. From now on the statistical comparisons between this and last year ought to favor those who believe in higher prices for cotton. But there is no gainsaying the fact that the fear of Uncle Sam's operations is restricting the trade in textiles and speculative buying in cotton as well as in grain. Most of the other commodities are about as they were.

In the automobile trade the demand is still subnormal, but production has been increased by the introduction of new models by some of the larger companies, and it is unofficially admitted that a slight improvement in the steel industry is discernible. In the stock market there has been a substantial advance from the low prices touched on November 10, but there is no boom in sight nor any reason to expect one until after Congress convenes. Those who are wise politically say that farm relief by the adoption of the debenture plan will be one of the first subjects considered, and that other questions will have to wait until this is settled.

The vigorous efforts that are being made to provide the unemployed with jobs, are, however, commencing to have their effect. They will probably put a good deal of money into circulation, and ought to quicken trade perceptibly.

An important New York newspaper publishes a dispatch from Vienna stating that there has been a military revolution in Russia. This report is unconfirmed as yet, but there are many who believe it. The first effect of a Russian revolution might be a slight depression in the market, but the ultimate result probably would be higher prices for staple commodities.

But these events seem to have but little effect upon American business, and some stockbrokers are now reducing their marginal requirements in an effort to re-attract those who are willing to purchase stocks on margin. The cheapness of money, which can frequently be borrowed on call at 1 per cent, should make such operations attractive to those who have an analytical mind and are willing to look before they leap and investigate before they buy any securities that they may be invited to purchase.

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THE WEEKLY PRICE GUIDE . . . .

Rise and Fall of the Market

THE recent rise in copper is reflected in the advance during the week, of approximately 2c. per lb. on brass and copper sheets, wire, rods and tubing at all buying centers. These advanced quotations are literally asking prices, since there is really little buying of copper metal. In sympathy with the movement in copper, scrap dealers have quoted higher prices this week, on used metal. Apart from the copper increase, solder rose ¼c. per lb. (22½c) and genuine, highest grade babbitt metal, 1c. per lb. (48c.) at New York warehouses. In the steel market, the firmness of price on bars, shapes and plates at $1.60, base, Pittsburgh, has exerted a strengthening effect on prices of sheets, wire and strip steel. Buying of appreciably large tonnages of material by railways and the automotive industry is not expected to materialize before 1931.

(*All prices as of Nov.* 21, 1930)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$16.69@$18.19
Northern Basic	19.89@ 20.39
Southern Ohio No. 2	19.89@ 20.39
NEW YORK—Tidewater Delivery	
No. 2 Southern (silicon 1.75@2.25)	18.00@ 18.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	14.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	20.00
Virginia No. 2	18.75@ 19.25
Basic	22.29
CHICAGO	
No. 2 Foundry, local (silicon 1.75@2.25)	19.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	18.20
PITTSBURGH, including freight charge ($1.76) from Valley:	
No. 2 Foundry	19.63@ 20.13
Basic	19.63@ 20.13
Bessemer	20.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.00
Cleveland	4.75
Cincinnati	4.45
New York	4 75@5.00
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed*	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	1.90@2.00	3.35†	3.00	3.40†
No. 12	1.95@2.05	3.45†	3.10	3.45†
No. 14	2.05@2.15	3.55†	3.20	3.50†
No. 16	2.15@2.25	3.65†	3.30	3.60†
Black				
Nos. 18 to 20	2.15@2.25	3.60†	3.40	3.70
No. 22	2.30@2.40	3.75†	3.55	3.85
No. 24	2.35@2.45	3.80†	3.60	3.90
No. 26	2.45@2.55	3.90†	3.70	4.00
No. 28	2.60@2.70	4.05†	3.85	4.15
Galvanized				
No. 10	2.20@2.30	3.65†	3.65	3.55
Nos. 12 to 14	2.30@2.40	3.75†	3.75	3.65
No. 16	2.40@2.50	3.85†	3.85	3.75
No. 18	2.55@2.65	4.00†	4.00	3.90
No. 20	2.70@2.80	4.15†	4.15	4.05
No. 22	2.75@2.85	4.20†	4.20	4.10
No. 24	2.90@3.00	4.35†	4.35	4.25
No. 26	3.15@3.25	4.60†	4.60	4.50
No. 28	3.40@3.50	4.85†	4.85	4.75

*Light Plates. †400 to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York		Cleveland		Chicago	
	Black	Galv.	Black	Galv.	Black	Galv.
1 to 3 in. butt..	56.14%	43.6%	53.3%	42.3%	57.3%	44.8%
3½ to 6 in. lap..	52.72%	40.18%	50.8%	37.8%	53.9%	41.4%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	—Diameter in Inches— External	Internal	Thickness Inches
⅛	$0.17	1.315	1.049	.133
¼	.23	1.66	1.38	.14
⅜	.27½	1.9	1.61	.145
½	.37	2.375	2.067	.154
¾	.58½	2.875	2.469	.203
1	.76½	3.5	3.068	.216
1¼	.92	4.0	3.548	.226
1½	1.09	4.5	4.026	.237
2	1.48	5.563	5.047	.258
2½	1.92	6.625	6.065	.28
3	2.50	8.625	8.071	.277

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb.:

—Thickness— Decimal	B.w.g. and Fractions	—Outside Diameter in Inches— ⅛	¼	⅜	½	1	1⅛	1¼
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb.:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	7.00	6.00	6.15
Hoop steel	3.75†	4.00	3.75†
Cold rolled strip steel	4.95	6.00	6.10
Floor plates	4.85†	5.30	5.00†
Cold fin., round or hexagon‡	3.40	3.65	3.35
Cold fin,, flat or square‡	3.90	4.15	3.85
Structural shapes	3.10†	3.00	3.00†
Soft steel bars	3.10†	3.00	3.00†
Soft steel bar shapes	3.10†	3.00	3.00†
Soft steel bands	3.40†	3.65	3.20†
Tank plates	3.10†	3.00	3.00†
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, ⅜-in. thick by ¾-in. wide. †400 to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire at New York warehouse—$\frac{3}{32}$, 8.35c. per lb.; ⅛, 7.85c. per lb.; $\frac{5}{32}$ to ¼, 7.35c. per lb.

METALS

Warehouse Delivery Prices in Cents Per Lb. for Small Lots:

Copper, electrolytic, New York			12.75
Tin, Straits, pigs, New York			27.75@28.75
Lead, pigs, E. St. Louis	4.95	New York	6.00@ 7.00
Zinc, slabs, E. St. Louis	4.30	New York	5.75@ 6.75

	New York	Cleveland	Chicago
Antimony, slabs	9.50@10.50	10.50	10.75
Copper sheets*	21.75	21.75	21.75
Copper wire*	13.25	13.37½	13.37½
Copper, drawn, round*	20.25	20.25	20.25
Copper tubing*	24.12½	24.12½	24.12½
Brass sheets, high*	18.62½	18.62½	18.62½
Brass tubing, high*	23.50	23.50	23.50
Brass rods, high*	16.87½	16.87½	16.87½
Brass wire, high*	19.12½	19.12½	19.12½

*Mill, base.

SHOP MATERIALS AND SUPPLIES

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%†	24.00@25.00	24.30	23.30
Zinc sheets (casks)	9.75@10.25	11.25	10.36
Solder (½ and ½)	22.50	21.50	20@22
Babbitt metal, delivered in case lots, New York, cents per lb.:			
Genuine, highest grade			48.00
Commercial genuine, intermediate grade			35.00
Anti-friction metal, general service			30.00
No. 4 babbitt, f.o.b.			10.00

†F.O.B.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va.:

	Nickel	Monel Metal
Sheets, full finished	52.00	42.00
Sheets, cold rolled	60.00	50.00
Strip, cold rolled	55.00	45.00
Rods, hot rolled	45.00	35.00
Rods, cold drawn	50.00	40.00
Tubing	75.00*	90.00†
Angles, hot rolled	50.00	40.00
Plates	52.00	42.00

*Seamless. †Welded.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars:

	New York	Cleveland	Chicago
Crucible copper	8.25 @8.50	7.25	7.25@ 7.75
Copper, heavy, and wire	7.50 @7.75	7.00	6.75@ 7.25
Copper, light, and bottoms	6.75 @7.00	6.50	6.00@ 6.50
Heavy lead	4.00	4.00	3.00@ 3.50
Tea lead	2.00	2.50	2.00@ 2.50
Brass, heavy, yellow	4.50 @4.75	5.00	4.00@ 4.50
Brass, heavy, red	7.00 @7.25	8.25	6.25@ 6.75
Brass, light	3.50 @3.75	4.00	3.50@ 4.00
No. 1 rod-brass turnings	4.75 @5.00	4.00	4.00@ 4.50
Zinc	2.00	1.50	1.25@ 1.50

TIN PLATES—Charcoal—Bright—Per box:

"AAA" Grade:	New York	Cleveland	Chicago
IC, 14x20	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13	$0.16	$0.15
Cotton waste, colored, per lb.	.09½	.12	.10
Wiping cloths, washed, white, per lb.	.14	38.00 per M	.14½
Sal soda, per lb.	.01¾	.02	.02
Roll sulphur, per lb.	.028	.03	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.	.098	.104	.10
Cutting oil, about 25% lard, in 5 gal. cans, per gal.	.65	.60	.60
Machine oil, medium-bodied (55 gal. steel bbl.) per gal.	.33	.36	.24
Belting—Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin.ft., per inch of width, for single ply:			
Medium grade	30–10%	30–10%	35%
Med. grade, heavy wgt.	30%	30 –5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft.:			
First grade	60%	50–10%	50%
Second grade	60–5%	60– 5%	50–10%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.031	$0.031	$0.0325
Cold fin. shafting	per lb.	.034	.034	.035
Brass rods	per lb.	.1687½	.1562½	.2125
Solder (½ and ½)	per lb.	.225	.225	.2975
Cotton waste, white	per lb.	.13	.13	.13
Disks, aluminum oxide mineral, cloth, No. 1 6-in. dia.	per 100	4.59	4.59	4.59
Lard cutting oil	per gal.	.65	.65	.65
Machine oil	per gal.	.33	.33	.33
Belting, leather, medium	off list	30–10%	30–10%	30–10%
Machine bolts, up to 1x30 in., full kegs	off list	65%*	65%*	50–10%*

*List prices as of April 1, 1927

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper*	$6.03	$6.03	$6.03
Emery cloth*	25.87	25.87	25.87
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper†	2.61	2.61	2.61
Cloth†	4.59	4.59	4.59
Fire clay, per 100 lb. bag	.90	.75	.75
Coke, prompt furnace, per net ton	Connellsville,		2.60
Coke, prompt foundry, per net ton	Connellsville,		3.50@4.85
White lead, dry	100 lb. kegs	New York,	13.75
White lead, in oil	100 lb. kegs	New York,	13.75
Red lead, dry	100 lb. kegs	New York,	13.75
Red lead, in oil	100 lb. kegs	New York,	15.25

*Less than 3 reams. †Less than 200.

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less	65%
Larger, up to 1 x 30-in., full kegs, list less	65%
Less than full kegs or case lots, add to list	10%
Fitting-up bolts: list less	45%
Lag screws:	
Up to ½-in. x 6-in., list less	65%
Larger, list less	65%
Less than full keg or case lots, add to list	10%
Rivets:	
Structural, round head, full kegs, net	$4.50
Structural, round head, broken kegs, net	6.00
Tank, 7/16-in. dia. and smaller, list less	65%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less	65%
Larger, up to 3-in., list less	65%
Less than keg or case lots, add to list	10%
Washers:	
Wrought, full kegs, per 100 lb., list less	$4.00
Wrought, broken kegs, per 100 lb., list less	2.00
Turnbuckles:	
With stub ends, list less	20–10%
Without stub ends, list less	55%
Chain:	
Proof coil, base, per 100 lb., net	$8.50
Cast iron welding flux, per lb., net	.35
Bronzing flux, per lb., net	.50

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Equipment Wanted

Mass., Boston — Bureau of Supplies & Accounts, Navy Dept., Washington, D. C.—will receive bids until Dec. 2 for electric drills, twist drillers, pliers, etc., at Navy Yard, here.

Ont., London — National Casket Co., 107 Niagara St., Toronto—complete equipment for the manufacture of steel caskets, for proposed addition to plant here. Estimated cost $50,000.

Opportunities for Future Business

Calif., Oakland—Hammer-Bray Co., 26th Ave. and East 12th St., manufacturers of stoves and ranges, are receiving bids for the construction of a 1 story factory on 102nd Ave. C. N. Burrell, American Bank Bldg., Archt. Noted Oct. 9.

Ill., Belleville — Oakland Foundry Co., H. Ehret, Secy. and Treas., awarded contract for rebuilding stove plant and foundry 1 story, 225 x 325 ft. recently destroyed by fire at A. St. and L. & N. R.R.

Ill., Chicago—Presto-O-Lite Co., subsidiary of Union Carbide & Carbon Co., 30 East 42nd St., New York, N. Y., plans the construction of a manufacturing plant here. Estimated cost to exceed $100,000. Private plans. Maturity in spring.

Ill., Waukegan—Public Service Co., 72 West Adams St., Chicago, awarded contract for the construction of a garage and storeroom addition at 201 North Buttrick St., here. $60,000.

Ind., Indianapolis—Beach & Preston, awarded contract for improvements to service station at 3815 East 10th St. Estimated cost $26,000.

Ind., Indianapolis—Hoosier Petroleum Co., 60 South Missouri St., plans additions to service station at 22nd St. and Capitol Ave. Estimated cost $25,000. Kolf & Deery, Engrs. Work will be done by owner's forces.

Ky., Lexington—Bd. of Trustees, University of Kentucky, had plans prepared for a 2 story farm engineering building, etc. Estimated cost $75,000. H. Meriwether, Dept. of Buildings & Grounds, Archt.

Mass., Boston — S. Lowe, 1 State St., is having plans prepared for a 1 story service station at Tremont and Church Sts. Private plans.

Mass., Cambridge (Boston P. O.)—School Commission, plans the construction of a technical school at Broadway, Felton and Cambridge Sts. Estimated cost $1,500,000. Architect not selected.

Mass., Malden—E. J. Lamothe Co., 25 Chestnut St., Somerville, manufacturers of galvanized ware, plans the construction of a 1 story, 100 x 138 ft. factory. Estimated cost $50,000. Miller & Levi, 46 Cornhill, Boston, Archt.

Mass., Milton—Town, C. M. Rogerson, Chn. of Building Commission, is having sketches made for the construction of a 2 story elementary school, including manual training department, etc., on Elliot St. Estimated cost $280,000. Shepard & Stearns, 65 Franklin St., Boston, Archts.

Minn., Minneapolis—Bd. of Public Welfare, City Hall, plans the construction of an industrial plant at municipal workhouse at Parkers Lake. Estimated cost $100,000. Architect not selected.

Mont., Billings—A. N. Eaton Metal Products Co., awarded contract for a 1 story plant for the manufacture of steel culverts for roads. Estimated cost $30,000.

N. J., Elizabeth—Bd. of Education, 417 South Broad St., postponed construction of 3 story boy's vocational school. $500,000. H. B. Brady, Inc., 333 North Broad St., Archts. Project may go ahead in Spring of 1931. Noted Sept. 4.

N. J., Montclair — Rudgers Builders Supply Co., 101 Greenwood Ave., is having plans prepared for a 1 and 2 story, 102 x 352 and 30 x 180 ft. garage, shop, etc. Estimated cost $150,000. Private plans. Public Service Production Co., 80 Park Pl., Newark, lessee.

N. J., New Brunswick — S. Kaplan, 295 Burnet St., will build a 1 story, 65 x 200 ft. garage. Estimated cost $150,000. H. G. Bach, 63 Schureman St., Archt. Work will be done by separate contracts.

N. J., Newark — A. Kaminski, c/o R. C. Klemm, 944 Broad St., postponed construction of 1 story factory and garage at 34 Oxford St. Estimated cost $40,000. Project abandoned.

N. J., Newark—Sander Mfg. Co., 298 8th Ave., manufacturers of meat chopping machines and parts, had plans prepared for a 1 story, 45 x 92 ft. addition to machine shop. Estimated cost $20,000.

N. J., Trenton—Trenton Potteries Co., North Clinton Ave., will soon award contract for the construction of a 1 story factory. Estimated cost $40,000. Lockwood, Greene Engineers Inc., 100 East 42nd St., New York, N. Y., Archts. and Engrs.

N. Y., New York—Corp., c/o Shampan & Shampan, 188 Montague St., Brooklyn, is having sketches made for the construction of a garage at Antin Pl. here. Estimated cost $300,000. Maturity indefinite.

N. Y., New York—Rosella Building Co., D. LaSala, Pres., 151 Mosholu Parkway, will build a 2 story, 110 x 120 ft. service garage at Webster Ave. and 176th St. Estimated cost $75,000. Siegel & Levy, 1775 Broadway, Archts. Work will be done by day labor and separate contracts.

N. Y., New York—Seven Hundred Ten 12th Ave. Corp., N. Wallenstein, Pres., awarded contract for a 3 story, 200 x 225 ft. garage at 643 West 51st St. Estimated cost $200,000. Noted Nov. 13.

O., Cincinnati—Buckeye Foundry Co., 2257 Buck St., awarded contract for the construction of a 1 story, 120 x 280 ft. foundry on Bekman St. Estimated cost $150,000. Noted Nov. 20.

O., Cleveland—Harris Seybold Potter Co., 4510 East 71st St., manufacturers of printing machinery, will discontinue Derby, Conn., plant and expand Cleveland and Dayton plants. Minor purchases of equipment and alterations at these plants.

Pa., Ambridge — National Electric Products Corp., 233 Broadway, New York, N. Y., plans expansion in line of manufacturing of additional products made of copper here, also at Bayonne, N. J. Estimated total cost $80,000. Maturity indefinite.

Pa., Philadelphia—Tinius Olsen Testing Machine Co., 500 North 12th St., awarded contract for a 1 story addition to plant. Estimated cost including equipment $69,000.

Wis., Milwaukee—A. E. Martin Foundry & Machine Co., 1521 West Bruce St., plans to rebuild iron foundry recently destroyed by fire. Estimated cost $40,000.

Wis., Milwaukee—Milwaukee Valve Co., 2371 Burrell St., awarded contract for a 1 and 2 story, 30 x 67 and 30 x 40 ft. additions to foundry and machine shop.

Wash., Longview—Weyerhauser Timber Co., awarded contract for a 150 ton bleached sulphite pulp mill. Work to start Dec. 1.

Wash., Tacoma—Pacific Ave. Building Co., plans the construction of a 2 story garage at Pacific and 11th Aves. Estimated cost $175,000.

Ont., Port Arthur — Hamilton By-Products Coke Ovens Ltd., plans the construction of a gas and coke plant. Estimated cost $3,500,000.

Germany, Cologne — Ford Motor Co., 3674 Schaefer Rd., Dearborn, Mich., will soon award contract for manufacturing and assembly plant here. Estimated cost to exceed $1,000,000.

Mexico, Mexico City—Ford Motor Co., 3674 Schaefer Rd., Dearborn, Mich., will soon award contract for an assembly plant here. Estimated cost $1,000,000.

Poland, Gdynia — Ford Motor Co., 3674 Schaefer Rd., Dearborn, Mich., plans the construction of a manufacturing and assembly plant here. Estimated cost to exceed $1,000,000.

South Africa—South African Steel & Iron Industrial Corp. Ltd., 82 Marshall St., Johannesberg, awarded contract for steel melting shop and rolling mills in connection with works at Pretoria.

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The Agent—
The Seller—
The Employee—
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